

TETRA TECH, INC.

TECHNICAL MEMORANDUM

Basewide Groundwater Monitoring Program Report
Fall 2005 (Q4)
Installation Restoration Program Site 3
Vandenberg Air Force Base, California

09 March 2006

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1.0 INTRODUCTION

This report documents the activities and results of the fall 2005 groundwater monitoring at Installation Restoration Program Site 3 (Old Railroad Pumping Station), Operable Unit 1, Vandenberg Air Force Base (AFB), Santa Barbara County, California. Samples were collected by Tetra Tech, Inc. (Tetra Tech) during November 2005. The location of Site 3 is shown on Figure 1.

The groundwater monitoring is being completed in accordance with the Basewide Groundwater Monitoring Program (BGMP) Work Plan (Tetra Tech 2000a), the BGMP Health and Safety Plan Addendum (Tetra Tech 2000b), the Basewide Sampling and Analysis Plan (Tetra Tech 2003a), the BGMP Quality Assurance Project Plan (QAPP) Addendum (Tetra Tech 2004), the Vandenberg AFB Hazardous Waste Management Plan (U.S. Air Force 2002), and the Waste Management Plan Addendum (Tetra Tech 2005). Regulatory oversight of the work is being performed by the California Department of Toxic Substances Control and Regional Water Quality Control Board—Central Coast Region.

Site background information is summarized in Section 2.0. The scope of work and methodology for groundwater monitoring at Site 3 are presented in Section 3.0. The results of the quarterly monitoring are presented in Section 4.0. Quality Assurance/Quality Control is discussed in Section 5.0. Recommendations for future sampling are presented in Section 6.0.

A complete description and history of the Site 3 and the results of previous environmental investigations can be found in the Draft Final Supplemental Remedial Investigation (RI) Report (Tetra Tech 2003b).

2.0 BACKGROUND

2.1 SITE DESCRIPTION

Installation Restoration Program Site 3 is located on Burton Mesa in the cantonment area of Vandenberg AFB; the majority of the base industrial, commercial, and residential activities are located in this area. Site 3 is southeast of New Mexico Avenue, between 6th Street and Pine Canyon Road (Figure 1). The southeast boundary of the site is adjacent to the active Vandenberg AFB landfill.

Site 3 was one of several former fuel transfer stations located at rail sidings around the perimeter of former Camp Cooke. Diesel fuel was transferred from railroad cars to six aboveground storage tanks (approximately 9,000 gallons each) and subsequently used to fuel military vehicles. The aboveground tanks were removed in 1961 (Jacobs Engineering Group, Inc. [JEG] 1997a). Five underground diesel fuel tanks were identified in the same area as the aboveground tanks during the summer of 2004. These tanks were excavated during the fall of 2004. If further information on the tank removals is required, please contact Vandenberg AFB 30 CES/CEVR.

2.2 HYDROGEOLOGY

Groundwater occurs on Burton Mesa as discontinuous lenses perched on low-permeability layers within the thin, surficial, unconsolidated sediment unit (Orcutt Formation) overlying Monterey Formation bedrock. At Site 3, groundwater zones have historically existed from approximately 6 feet below ground surface (bgs) in monitoring well 3-MW-5 to approximately 54 feet bgs in well 3-MW-12D. The substantial variability in groundwater elevations results from infiltrating groundwater being intercepted by discontinuous clay layers and cemented sand stringers within the alluvium (JEG 1997b). Because of multiple, discontinuous clay layers at various depths, very little groundwater reaches the bedrock/alluvium contact. Results of this and previous investigations indicate that a continuous piezometric surface is not present, and a site-specific hydraulic gradient and direction cannot be reliably

calculated; therefore, a groundwater contour map is not included in this report. Groundwater has not been encountered in the western and eastern portions of the site.

Groundwater levels measured in November 2005 indicate that the groundwater elevation ranged from approximately 369 to 439 feet above mean sea level (Table 1). Water levels in Canyon well 3-MW-5 have historically been lowest during fall quarters (Figure 3).

3.0 SCOPE OF WORK

The work performed during fall 2005 at Site 3 included measuring groundwater levels, collecting groundwater for field and laboratory analysis, and preparing this report.

3.1 GROUNDWATER MONITORING METHODOLOGY

Five monitoring wells were sampled at Site 3 during fall 2005. MicroPurge and Grundfos pumps were used for purging groundwater at wells 3-MW-3 through 3-MW-5, 3-MW-11, and 3-MW-12A. A duplicate sample was collected from well 3-MW-5. Wells 3-MW-10, 3-MW-12B, 3-MW-12C, and 3-MW-12D were dry and were not sampled. Sampling was conducted in accordance with the documents cited in Section 1.0. Measured groundwater elevations are presented in Table 1. Purge records are presented in Appendix A.

In general, wells were purged until a minimum of one pump and tubing volume of water (for MicroPurge pumps) or a minimum of three well volumes of water (for Grundfos pumps) were removed and water quality parameters had stabilized. Criteria for determining stabilization are three successive measurements of temperature within ± 1 degree Celsius, pH within ± 0.1 , conductivity within ± 5 percent, and a turbidity reading of less than 5 nephelometric turbidity units (NTUs). In cases where stability or a turbidity reading of less than 5 NTUs was not obtained, samples were collected after purging a minimum of five pump and tubing volumes of water (for MicroPurge pumps) or a minimum of five well volumes of water (for Grundfos pumps).

3.1.2 MicroPurge Groundwater Sampling

MicroPurge sampling was conducted at wells 3-MW-3 and 3-MW-11. Pumping rates were calibrated for each well prior to purging to maintain a static water level (i.e., no drawdown).

3.1.3 Standard Groundwater Sampling

A 2-inch Grundfos pump was used for purging groundwater at wells 3-MW-4, 3-MW-5, and 3-MW-12A. These monitoring wells were purged dry and sampled after sufficient recharge using disposable Teflon bailers.

3.2 SURFACE WATER SAMPLING

Surface water samples have historically been collected from the two seep locations 3-SP-1 and 3-SP-2 (Figure 1). The surface seeps represent potential exposure points for human and ecological receptors. During previous sampling rounds, with the exception of winter 2000, winter 2001, and winter and spring 2005 (3-SP-1 only) there was insufficient surface water present in the Oak Canyon seeps for sampling. Tetra Tech inspects the seep and surface water locations on a quarterly basis for the presence of seepage and standing water. During summer and fall 2005, there was insufficient surface water present in the Oak Canyon seeps for sampling.

4.0 RESULTS

Temperature, conductivity, pH, and turbidity were measured in the field during purging. Readings taken immediately prior to sampling are presented in Table 2. Fixed laboratory analyses were performed by EMAX Laboratories in Torrance, California. Samples were analyzed according to the work plan (Tetra Tech 2000a). Samples were analyzed for dissolved and total metals by U.S. Environmental Protection Agency (EPA) methods SW6010B and SW7470A, total petroleum hydrocarbons as diesel (TPHd) by EPA method SW8015B, volatile organic compounds (VOCs) by EPA method SW8260B, polynuclear aromatic hydrocarbons (PAHs) by EPA method SW8270C with selected ion monitoring (SIM), 1,4-dioxane by modified EPA method SW8270C SIM, and hexavalent chromium by EPA method E218.6. Laboratory analyses and data validation were conducted according to the QAPP Addendum (Tetra Tech 2004). Data validation was performed on 100 percent of the analytical data. Analytical results are presented in Tables 3 through 7 and on Figure 1. Historical data for key contaminants of concern (COCs) are presented in Table 8 and on Figures 2A and 2B. Figure 2A contains data for key COCs detected from fall 1999 through fall 2003 and Figure 2B contains key COC data from spring 2004 to present. Hydrographs showing historical TPHd concentrations for well 3-MW-5 and historical TPHd and trichloroethene (TCE) concentrations for wells 3-MW-11 and 3-MW-12A are presented on Figure 3. Chain-of-custody records are provided in Appendix B.

4.1 METALS

Wells 3-MW-3, 3-MW-4, 3-MW-5, 3-MW-11, and 3-MW-12A were sampled for dissolved and total metals. Dissolved metal concentrations were compared to the 95th percentile background threshold values (BTVs) for groundwater on Burton Mesa (JEG 1994) and primary maximum contaminant levels (MCLs). Analytical results are presented in Table 3 and results for dissolved metals above BTVs are presented on Figure 1.

Dissolved metals were detected above BTVs in groundwater from all wells sampled for metals this quarter. Dissolved arsenic was detected above the MCL of 10 micrograms per liter ($\mu\text{g/L}$) and the BTV of 7 $\mu\text{g/L}$ in groundwater from well 3-MW-3 at a concentration of 52.1 $\mu\text{g/L}$. Dissolved chromium was detected above the MCL of 50 $\mu\text{g/L}$ and the BTV of 20 $\mu\text{g/L}$ in groundwater from well 3-MW-11 at a concentration of 58.6 $\mu\text{g/L}$.

The groundwater sample from well 3-MW-5 was analyzed for hexavalent chromium. Hexavalent chromium was not detected in the parent or the duplicate sample during this quarter (Table 4).

An assessment of the usefulness of continuing metals analyses at Site 3 under the BGMP was conducted during fall 2005 report preparation by evaluating metals concentrations in groundwater and the results of the baseline risk assessment. Total metals analyses were conducted under the BGMP to support the RI and preparation of the baseline risk assessment. The electronic version of the Final RI Report (Tetra Tech 2006) is complete and no further total metals analyses are needed. During this evaluation, risks identified for dissolved metals in groundwater in the electronic version of the Final RI Report (Tetra Tech 2006) were reviewed. Carcinogenic risks greater than 1×10^{-6} or Hazard Indices greater than 1 were identified in the RI Report for arsenic, antimony, and cadmium (Tetra Tech 2006: 7-8). A table containing historic concentrations of these metals in groundwater from Site 3 wells and hydrographs for wells with metals concentrations above MCLs and BTBs are included in Appendix C.

4.2

TOTAL PETROLEUM HYDROCARBONS

Samples from wells 3-MW-5, 3-MW-11, and 3-MW-12A were analyzed for TPHd. TPHd were detected above the Vandenberg AFB leaking underground fuel tank (LUFT) action level of 1 milligram per liter (mg/L) for TPH in water in samples from all three wells at concentrations ranging from 2.1 to 6.7 mg/L (Table 5).

Hydrographs presenting visual comparisons of groundwater elevations and TPHd concentrations for wells 3-MW-5, 3-MW-11, and 3-MW-12A have been included to expedite review (Figure 3). There is no apparent overall correlation between contaminant concentrations and groundwater elevations. However, TPHd concentrations have generally been increasing in groundwater from wells 3-MW-5 and 3-MW-12A since fall 2002, and in well 3-MW-11 since fall 2004.

4.3

VOLATILE ORGANIC COMPOUNDS

Wells 3-MW-3, 3-MW-4, 3-MW-5, 3-MW-11, and 3-MW-12A were sampled for VOCs during fall 2005. Analytical results are presented in Table 6. Three separate groundwater contamination plumes centered around wells 3-MW-3, 3-MW-12A, and 3-MW-5 are shown on Figure 2B. In general, the vertical and lateral extent of these plumes is governed by the limited extent of groundwater at the site.

Tetrachloroethene (PCE) was detected above the MCL of 5 µg/L in groundwater from well 3-MW-3 at a concentration of 10 µg/L. This concentration is similar to the concentration detected during spring 2005 (11 µg/L). PCE concentrations in groundwater from well 3-MW-3 have generally increased since fall 1999 (Figure 3), when a concentration of 1.5 µg/L was detected (Table 8). TCE was detected above the MCL of 5 µg/L in groundwater from wells 3-MW-4, 3-MW-11, and 3-MW-12A at concentrations of 230, 24, and 13 µg/L, respectively. TCE concentrations were within the ranges of those previously detected. The compound *cis*-1,2-dichloroethene (DCE) was detected above the MCL of 6 µg/L in groundwater from wells 3-MW-4, 3-MW-11, and 3-MW-12A at concentrations of 66, 7.2, and 8 µg/L, respectively. Concentrations of *cis*-1,2-DCE were within the range of those previously detected. Vinyl chloride was detected above the MCL of 0.5 µg/L in groundwater from wells 3-MW-11 and 3-MW-12A at concentrations of 0.91 and 17 µg/L, respectively. Vinyl chloride concentrations in 3-MW-12A have been decreasing since fall 2003 (Figure 3). The compound 1,4-dichlorobenzene (DCB) was detected above the MCL of 5 µg/L in groundwater from well 3-MW-5 at a concentration of 8 µg/L (9 µg/L in the duplicate sample). The 1,4-DCB concentration detected during fall 2005 was within the range of those previously detected.

A visual comparison of groundwater elevations and TCE concentrations for well 3-MW-12A is presented in Figure 3. There is no apparent correlation between groundwater elevation and TCE concentration in well 3-MW-12A. TCE concentrations in groundwater from well 3-MW-12A have been decreasing since spring 2003.

The groundwater sample from well 3-MW-5 was analyzed for 1,4-dioxane; this compound was not detected (Table 7).

4.4

POLYNUCLEAR AROMATIC HYDROCARBONS

Groundwater samples from wells 3-MW-5 and 3-MW-12A were analyzed for PAHs. Naphthalene was detected in the groundwater sample from well 3-MW-12A at a concentration of 0.32 µg/L (Table 5 and Figure 1). In addition, fluorene was detected in groundwater from well 3-MW-5 at a concentration of 0.85 µg/L (1.1 µg/L in the duplicate sample).

5.0 QUALITY ASSURANCE/QUALITY CONTROL

All of the analytical data presented in this report have been validated according to the BGMP QAPP Addendum (Tetra Tech 2004). The data validation process includes review of sample preservation, temperature, and hold times; detection and quantitation limits; instrument calibration; and equipment blank, trip blank, method blank, laboratory control sample, and matrix spike/matrix spike duplicate. Data validation qualifiers and comments are provided on the data tables to indicate the results of the data validation and to quantitatively indicate the usability of the data. In addition, field sampling records are reviewed to assess the potential for any field conditions to adversely impact the data quality.

Zinc was qualified for blank contamination due to its presence in the associated blanks. This discrepancy is considered minor and does not significantly impact the data quality or interpretations presented in this report. The data quality objectives for the fall 2005 sampling at Site 3 were achieved.

6.0 RECOMMENDATIONS

Recommendations for the fall 2005 Groundwater Monitoring Report for Site 3 are presented below:

1. Tetra Tech and the Air Force recommend removing total metals analysis from the BGMP sampling plan for all wells at Site 3. Total metals analyses were conducted under the BGMP to support the RI Report and baseline risk assessment. The electronic version of the Final RI Report (Tetra Tech 2006) is complete and no further total metals analyses are needed.
2. Tetra Tech and the Air Force recommend reducing the analyte list for dissolved metals at Site 3 to the three metals for which carcinogenic risks greater than 1×10^{-6} or hazard indices greater than one were identified in the Final RI Report (Tetra Tech 2006: 7-8): arsenic, antimony, and cadmium. Continued analysis for other metals is not necessary to support current activities at the site.
3. Tetra Tech and the Air Force recommend reducing the dissolved metals sampling frequency for wells 3-MW-5 and 3-MW-12A from semiannual to annual during fall quarters. Concentrations of arsenic, antimony, and cadmium have been stable (Figure C-1). A supporting table and hydrographs are presented in Appendix C.
4. Tetra Tech and the Air Force recommend removing dissolved metals analyses for wells 3-MW-4 and 3-MW-10. Arsenic, antimony, and cadmium have not been detected in groundwater from well 3-MW-4 during the last 4 sampling rounds. Arsenic and antimony have only been detected once each in groundwater from well 3-MW-10 and these concentrations were below the BTVs and MCLs (Table C-1). Cadmium has not been detected in groundwater from 3-MW-10. A supporting table and hydrographs are presented in Appendix C.
5. Tetra Tech and the Air Force recommend removing hexavalent chromium analysis for well 3-MW-5. Hexavalent chromium has not been detected for four consecutive sampling rounds in groundwater from this well (Table 4 and Appendix D).
6. Tetra Tech and the Air Force recommend removing 1,4-dioxane analysis for wells 3-MW-5 and 3-MW-10. The compound 1,4-dioxane has not been detected for four consecutive sampling rounds in groundwater from well 3-MW-5 (Table 4 and Appendix E). Well 3-MW-10 has been dry for four of six sampling rounds since 1,4-dioxane analysis began in spring 2003 (Table 8). Groundwater from this well was analyzed for 1,4-dioxane during the other two sampling rounds

(spring 2003 and spring 2005), but the compound was not detected (Appendix E). In the Fall 2002 Groundwater Monitoring Report for Site 3, Tetra Tech and the Air Force recommended semiannual 1,4-dioxane analysis for well 3-MW-10 due to its proximity to well 3-MW-5 (Tetra Tech 2002a), not due to any previous detections. Since Tetra Tech and the Air Force recommend removing 1,4-dioxane analysis for well 3-MW-5, removal of 1,4-dioxane analysis for well 3-MW-10 is also warranted, even though four quarters of 1,4-dioxane data are not available for this well.

7. Pursuant to recommendations for sampling for emergent compounds under the BGMP from the Final Supplemental Basewide Preliminary Assessment (PA) for Identification of Emergent Compounds of Concern Usage prepared by Metcalf & Eddy (M&E) (M&E 2005), Tetra Tech and the Air Force recommend adding a screening round of analysis for 1,2,3-trichloropropane (TCP) for well 3-MW-12A during spring 2006. In addition, a new well will be incorporated into the BGMP and Tetra Tech and the Air Force will recommend a screening round of TCP analysis during its first BGMP sampling round. This well will be installed during the Site 3 IRA near boring 3-B-10, where TCE was detected in subsurface soil. During the sampling round following collection of TCP screening samples, Tetra Tech and the Air Force recommend that analysis for TCP be discontinued for wells where TCP is not detected and continued semiannually for wells where TCP is detected.

These recommendations were developed in accordance with the Air Force Center for Environmental Excellence Long-Term Monitoring Optimization Guide (U.S. Air Force 1997) and the decision tree developed by Tetra Tech for the BGMP at Vandenberg AFB (Tetra Tech 2002b). Using the decision tree, COC concentrations were evaluated for all Site 3 wells.

The spring 2006 sampling will be conducted according to the Final BGMP Work Plan (Tetra Tech 2000a).

7.0 REFERENCES

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Tetra Tech, Inc.

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Tetra Tech, Inc.

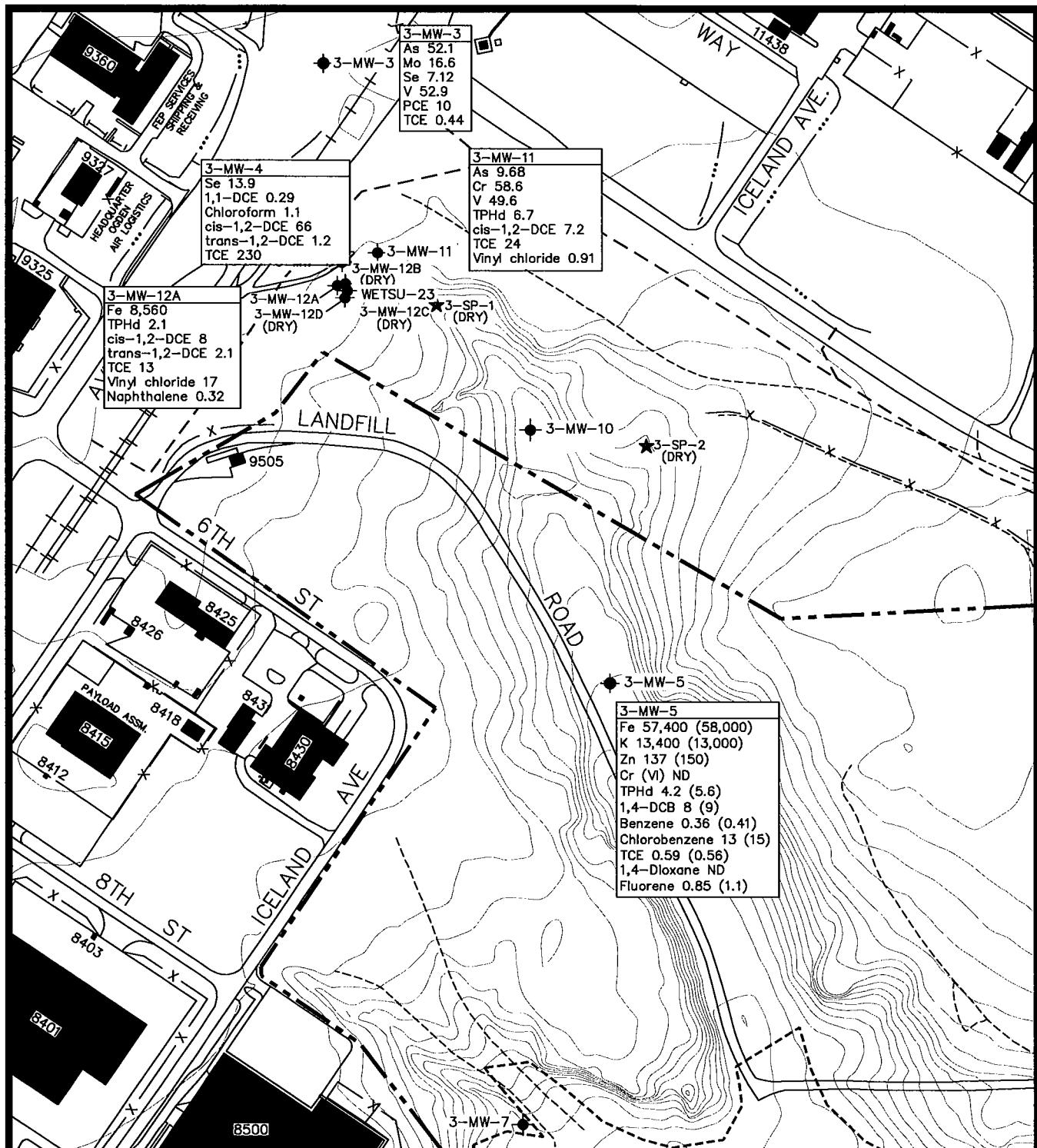
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LEGEND

- 200' CONTOUR OF GROUND SURFACE ELEVATION IN FEET ABOVE MSL (5-FOOT INTERVALS) (NAVD 1988)
- x- FENCE
- PAVED ROAD OR STREET
- - - DIRT ROAD
- BUILDING
- CONCRETE OR PAVED AREAS
- SITE BOUNDARY
- DRAINAGE
- GROUNDWATER MONITORING WELL
- ★ SURFACE WATER SEEP
- ND NOT DETECTED; RESULT IS LESS THAN THE METHOD DETECTION LIMIT
- DRY LOCATION WAS DRY OR HAD INSUFFICIENT WATER FOR SAMPLING.

0 162.5' 325' 487.5'
SCALE

NOTE(S):
RESULTS FOR ALL COMPOUNDS EXCEPT TPHd ARE IN $\mu\text{g}/\text{L}$. TPHd RESULTS ARE IN mg/L.
RESULTS IN PARENTHESES ARE FROM DUPLICATE SAMPLES. METALS RESULTS ARE FOR FILTERED GROUNDWATER WITH CONCENTRATIONS ABOVE BTVs. SUSPECTED LABORATORY CONTAMINANTS ARE NOT SHOWN.

**UNITED STATES AIR FORCE
VANDENBERG AIR FORCE BASE**
**SITE 3
OLD RAILROAD PUMPING STATION
SITE PLAN AND ANALYTICAL RESULTS
FALL 2005**

TETRA TECH, INC.

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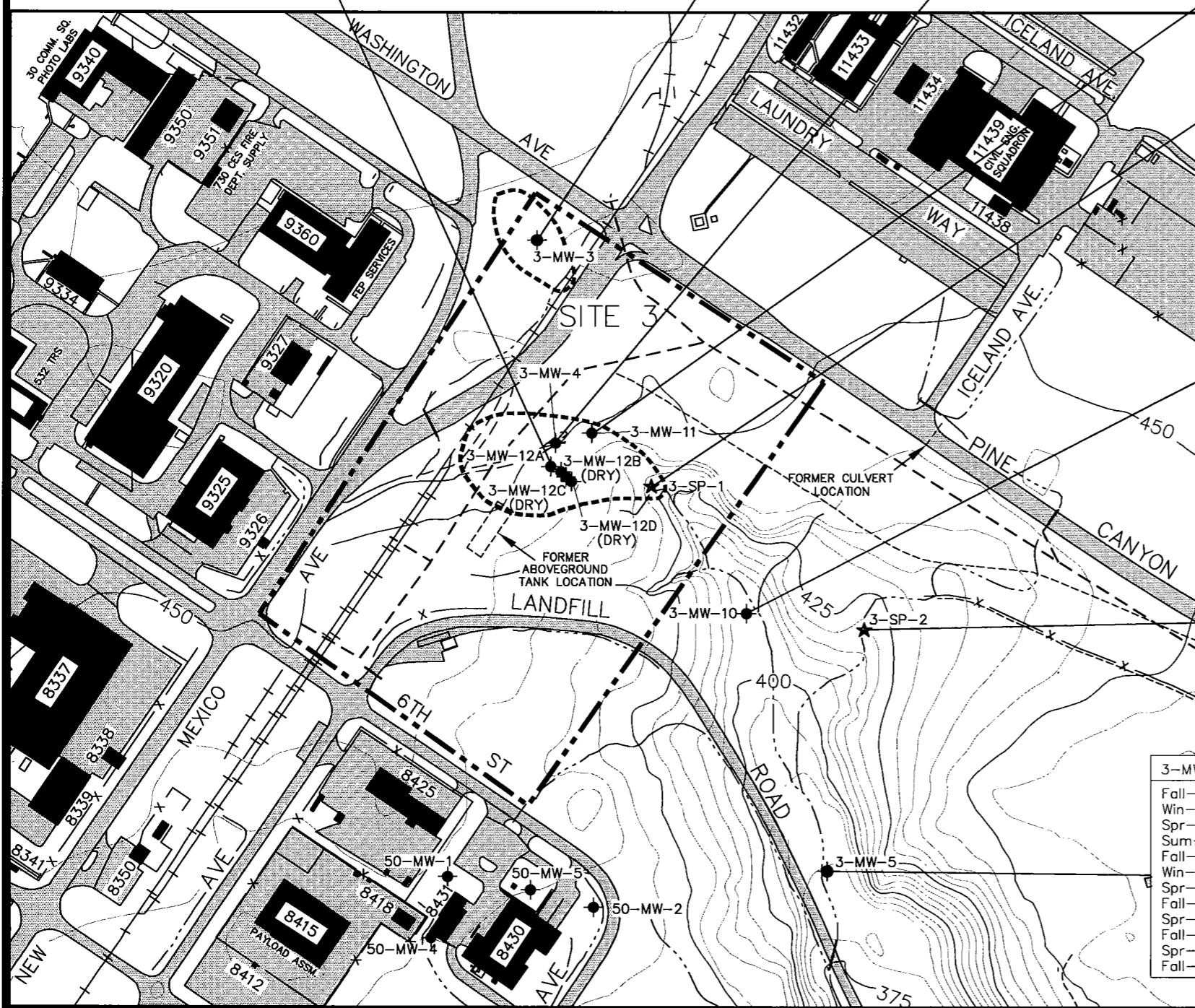
TASK NO.	DATE	DRAWN BY	MADE FROM	DWG NO.	Figure
99105-18	3/2/06	PRICHARD	TAB25	5403	1

3-MW-12A	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	TPH
Fall-99	0.78	2.2	1.5	5.6	1.3
Win-00	450	170	2.3	ND	ND
Spr-00	260	230	13.0	47	ND
Sum-00	130	120	78	60	0.57
Fall-00	210	260	42	51	1.2
Win-01	180	140	6.8	18	ND
Spr-01	110	140	21.0	78	0.66
Fall-01	100	240	89	110	1.2
Spr-02	110	210	18	81	0.93
Fall-02	15	130	120	82	0.82
Spr-03	681	340	30.1	82.9	0.90
Fall-03	183	321	258	136	1.11

3-MW-3	PCE	TCE	TPHd
Fall-99	1.5	ND	ND
Win-00	1.5	0.81	ND
Spr-00	2.4	ND	ND
Sum-00	ND	ND	ND
Fall-00	2.3	ND	ND
Win-01	3.1	ND	ND
Spr-01	1.0	ND	ND
Fall-01	4.4	ND	ND
Spr-02	5.6	ND	ND
Fall-02	5.4	ND	ND
Spr-03	8.56	0.35	NA
Fall-03	7.30	0.38	NA

3-MW-4	TCE	cis-1,2-DCE	trans-1,2-DCE	TPHD
Fall-99	260	1.30	1.7	ND
Win-00	120	19	ND	ND
Spr-00	200	18	ND	ND
Sum-00	130	36	ND	ND
Fall-00	200	86	ND	ND
Win-01	67	8.1	ND	ND
Spr-01	260	28	ND	ND
Fall-01	93	11	ND	ND
Spr-02	70	4.8	ND	ND
Fall-02	180	61	3.5	ND
Spr-03	200	46.2	0.86	NA
Fall-03	215	82.9	1.31	NA

3-MW-11	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl chloride	TPHD
Fall-99	7.6	7.1	ND	ND	ND
Win-00	4.3	4.8	ND	ND	ND
Spr-00	56	5	ND	ND	ND
Sum-00	27	4.3	ND	ND	ND
Fall-00	17	6.6	ND	ND	ND
Win-01	11	4.7	ND	ND	ND
Spr-01	63	2.9	ND	ND	ND
Fall-01	38	6.4	ND	ND	ND
Spr-02	100	8.1	ND	ND	ND
Fall-02	140	17	2.9	ND	ND
Spr-03	97.8	55.6	0.35	ND	NA
Fall-03	111	37.4	0.29	ND	NA



3-SP-1	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl Chloride	TPHd
Fall-99	DRY	DRY	DRY	DRY	DRY
Win-00	0.82	1.9	ND	ND	ND
Spr-00	DRY	DRY	DRY	DRY	DRY
Sum-00	DRY	DRY	DRY	DRY	DRY
Fall-00	DRY	DRY	DRY	DRY	DRY
Win-01	43	45	0.54	0.64	ND
Spr-01	DRY	DRY	DRY	DRY	DRY
Fall-01	DRY	DRY	DRY	DRY	DRY
Spr-02	DRY	DRY	DRY	DRY	DRY
Fall-02	DRY	DRY	DRY	DRY	DRY
Spr-03	DRY	DRY	DRY	DRY	DRY
Fall-03	DRY	DRY	DRY	DRY	DRY

3-MW-10	TCE	cis-1,2-DCE	TPHd
Fall-99	DRY	DRY	DRY
Win-00	DRY	DRY	DRY
Spr-00	13	15	ND
Sum-00	14	25	ND
Fall-00	4.3	0.74	ND
Win-01	0.6	ND	ND
Spr-01	ND	6.1	ND
Fall-01	5.2	ND	ND
Spr-02	ND	18	ND
Fall-02	DRY	DRY	DRY
Spr-03	ND	ND	0.30
Fall-03	DRY	DRY	DRY

3-SP-2	TCE	cis-1,2-DCE	trans-1,2-DCE	TPHd
Fall-99	DRY	DRY	DRY	DRY
Win-00	ND	ND	ND	ND
Spr-00	DRY	DRY	DRY	DRY
Sum-00	DRY	DRY	DRY	DRY
Fall-00	DRY	DRY	DRY	DRY
Win-01	ND	ND	ND	ND
Spr-01	DRY	DRY	DRY	DRY
Fall-01	DRY	DRY	DRY	DRY
Spr-02	DRY	DRY	DRY	DRY
Fall-02	DRY	DRY	DRY	DRY
Spr-03	DRY	DRY	DRY	DRY
Fall-03	DRY	DRY	DRY	DRY

3-MW-5	TCE	Benzene	Chlorobenzene	1,4-DCB	cis-1,2-DCE	TPHd
Fall-99	ND	ND	2.1	8.2	ND	0.73
Win-00	ND	ND	1.4	ND	ND	ND
Spr-00	ND	ND	10	ND	ND	ND
Sum-00	ND	2.5	48	18	ND	ND
Fall-00	ND	0.56	12	12	ND	ND
Win-01	ND	1.0	30	6.6	0.8	ND
Spr-01	ND	1.7	49	13	0.6	ND
Fall-01	ND	ND	ND	7.7	ND	ND
Spr-02	ND	ND	9.8	7.0	ND	0.55
Fall-02	5.1	ND	4.4	4.9	3.3	ND
Spr-03	ND	0.80	20.1	9.94	0.12	0.60
Fall-03	ND	0.30	6.16	5.20	ND	1.3

LEGEND

CONTOUR OF GROUND SURFACE
ELEVATION IN FEET ABOVE MSL
(5-FOOT INTERVALS) (NAVD 1988)

— x — FENCE

 PAVED ROAD OR STREET

----- DIRT ROAD

L-1 RAILROAD

1788 BUILDING

CONCRETE OR PAVED AREAS

[View Details](#)

----- UNDERGROUND CULVERT PIPE
----- DRAINAGE
◆ 3-MW-1 EXISTING GROUNDWATER MONITORING
WELL

A.7.22 SURFACE WATER SEEP

SITE BOUNDARY

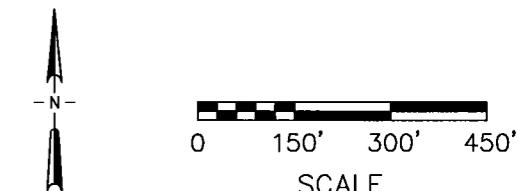
**ESTIMATED EXTENT OF KEY COCs
ABOVE MCLs IN GROUNDWATER**

NOT ANALYZED

ND NOT DETECTED; RESULT IS LESS THAN THE METHOD DETECTION LIMIT

DRY WELL OR SEEP WAS DRY OR HAD INSUFFICIENT WATER FOR SAMPLING

NOTE(S): RESULTS FOR ALL COMPOUNDS EXCEPT TPHd ARE IN $\mu\text{g}/\text{L}$. TPHd RESULTS ARE IN mg/L.



UNITED STATES AIR FORCE
VANDENBERG AIR FORCE BASE

SITE 3
OLD RAILROAD PUMPING STATION
HISTORICAL ANALYTICAL RESULTS FOR KEY
CONTAMINANTS OF CONCERN
FALL 1999 THROUGH FALL 2003

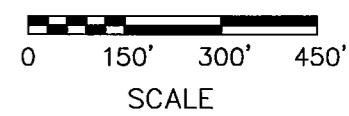
TETRA TECH, INC.

4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

DATE DRAWN BY MADE FROM DWG NO. Figure
8/30/05 RANDALL TAB25 5088 2A

200	CONTOUR OF GROUND SURFACE ELEVATION IN FEET ABOVE MSL (5-FOOT INTERVALS) (NAVD 1988)
X	FENCE
PAVED ROAD OR STREET	PAVED ROAD OR STREET
-----	DIRT ROAD
+ +	RAILROAD
1788	BUILDING
■■■■■	CONCRETE OR PAVED AREAS
- - - -	UNDERGROUND CULVERT PIPE
- - - - -	DRAINAGE
♦	EXISTING GROUNDWATER MONITORING WELL
★	★ 3-SP-1 SURFACE WATER SEEP
- - - -	SITE BOUNDARY
- - - - -	STORMWATER DIVERSION PIPE
- - - - -	ESTIMATED EXTENT OF KEY COCs ABOVE MCLs IN GROUNDWATER
NA	NOT ANALYZED
ND	NOT DETECTED; RESULT IS LESS THAN THE METHOD DETECTION LIMIT.
DRY	WELL OR SEEP WAS DRY OR HAD INSUFFICIENT WATER FOR SAMPLING

NOTE(S): RESULTS FOR ALL COMPOUNDS EXCEPT TPHd ARE IN $\mu\text{g}/\text{L}$. TPHd RESULTS ARE IN mg/L.



UNITED STATES AIR FORCE VANDENBERG AIR FORCE BASE

SITE 3

OLD RAILROAD PUMPING STATION
HISTORICAL ANALYTICAL RESULTS FOR KEY
CONTAMINANTS OF CONCERN
SPRING 2004 THROUGH FALL 2005



TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110-2847

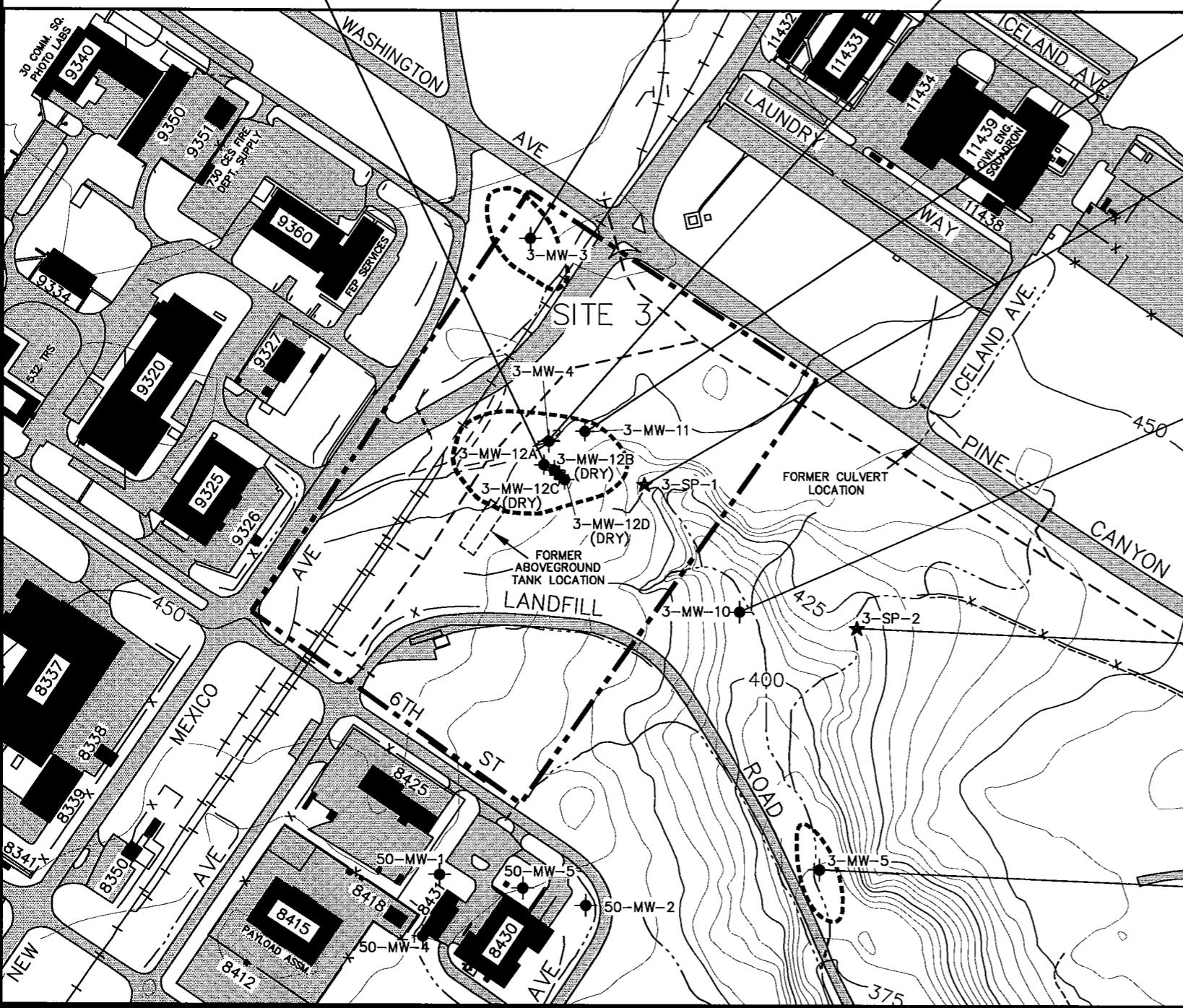
TASK NO.	DATE	DRAWN BY	MADE FROM	DWG NO.	Figure
99105-18	1/17/06	RANDALL	TAB25	5410	2B

3-MW-12A	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl chloride	TPHd
Spr-04	83	380	29	68	1.3
Fall-04	21	14	5.5	28	1
Spr-05	2	19	5.7	19	1.6
Fall-05	13	8	2.1	17	2.1

3-MW-3	PCE	TCE	TPHd
Spr-04	7.9	0.37	NA
Fall-04	7.3	0.38	NA
Spr-05	11	0.51	NA
Fall-05	10	0.44	NA

3-MW-4	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl chloride	TPHd
Spr-04	56	8.7	ND	NA	
Fall-04	110	50	1.4	NA	
Spr-05	96	7.8	0.26	NA	
Fall-05	230	66	1.2	NA	

3-MW-11	TCE	cis-1,2-DCE	trans-1,2-DCE	Vinyl chloride	TPHd
Spr-04	100	15	0.23	ND	NA
Fall-04	23	31	0.24	36	1.2
Spr-05	9.9	1.2	ND	0.67	7.2
Fall-05	24	7.2	ND	0.91	6.7



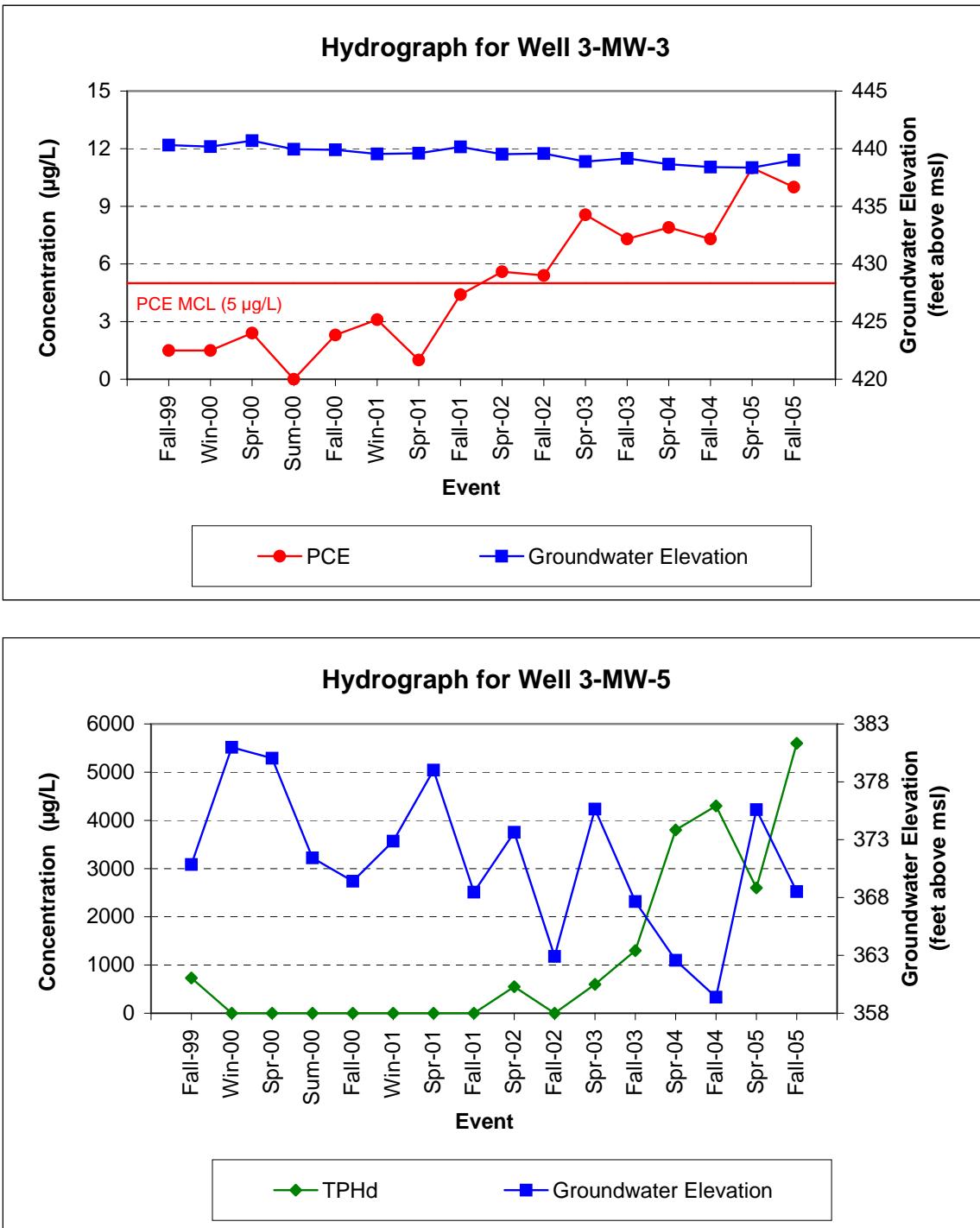


Figure 3. Site 3 Historical Groundwater Elevations and Concentrations of TPHd and TCE.

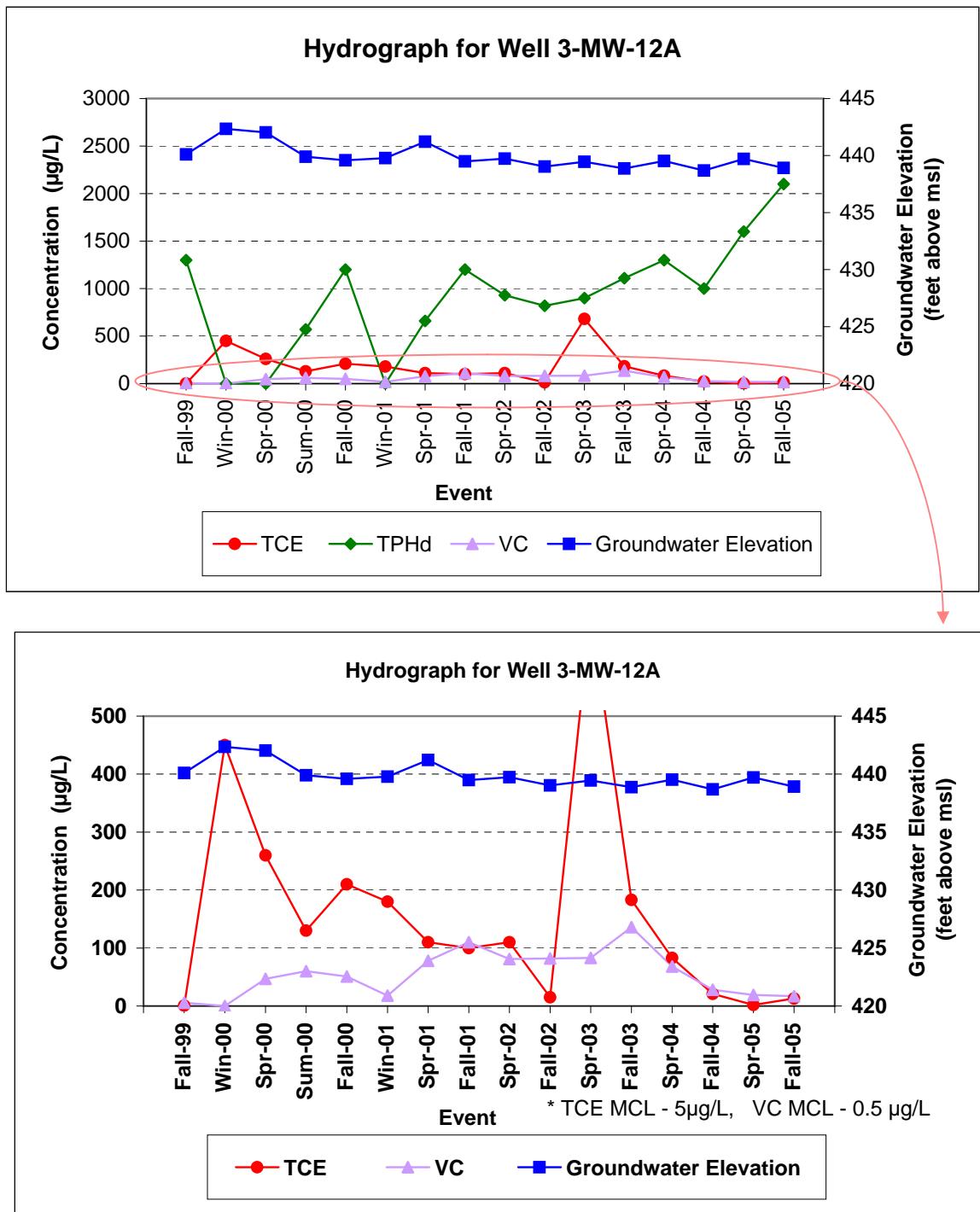


Figure 3. Site 3 Historical Groundwater Elevations and Concentrations of TPHd and TCE.

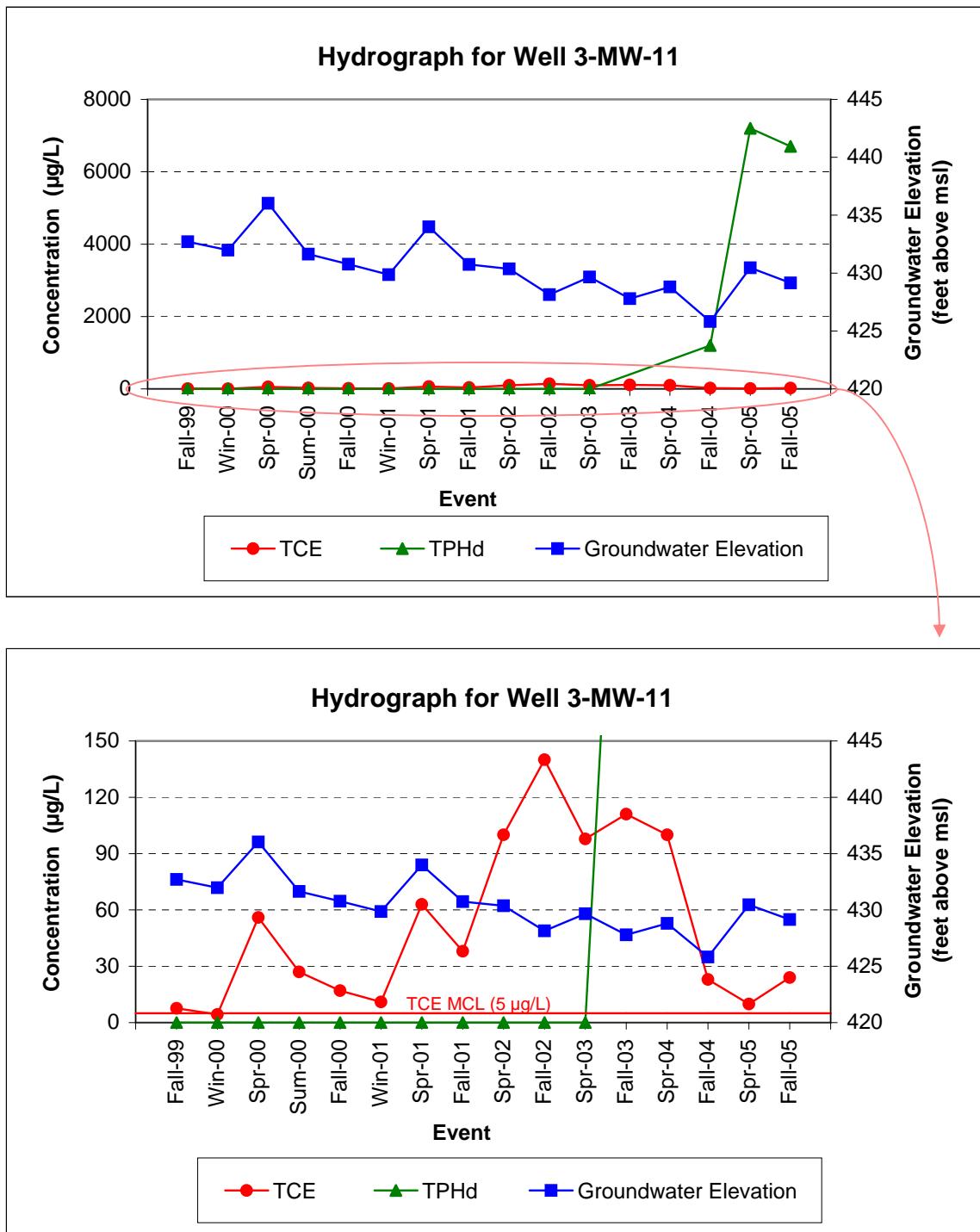


Figure 3. Site 3 Historical Groundwater Elevations and Concentrations of TPHd and TCE.

Table 1
Groundwater Elevations
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Monitoring Well	Top of Casing Elevation (feet above msl)	Date Measured	Groundwater Depth (feet below TOC)	Groundwater Elevation (feet above msl)		
				Fall 2005	Fall 2005	Spring 2005
3-MW-3	456.01	01-Nov-05	17.01	439.00	438.36	438.41
3-MW-4	450.67	01-Nov-05	11.56	439.11	439.60	438.84
3-MW-5	381.92	01-Nov-05	13.41	368.51	375.59	359.38
3-MW-10	401.19	01-Nov-05	DRY	392.56	DRY	362.57
3-MW-11	452.49	01-Nov-05	23.34	429.15	430.46	425.82
3-MW-12A	449.35	01-Nov-05	10.43	438.92	439.71	428.81
3-MW-12B	448.66	01-Nov-05	DRY	DRY	DRY	439.52
3-MW-12C	448.36	01-Nov-05	DRY	DRY	DRY	415.77
3-MW-12D	448.25	01-Nov-05	DRY	DRY	DRY	401.61
						394.32

Definition(s):

msl - mean sea level
TOC - top of well casing

Table 2
Water Quality Parameters
Fall 2005

IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California^a

Sampling Location	3-MW-3	3-MW-4	3-MW-5	3-MW-11	3-MW-12A
Sample ID	V3MW3	V3MW4	V3MW5M	V3MW11	V3MW12A
Collection Date	11-Nov-05	14-Nov-05	14-Nov-05	11-Nov-05	15-Nov-05
Field Parameters¹:					
Temperature (° Celsius)	19.10	18.97	17.83	18.01	19.20
Conductivity ($\mu\text{mhos/cm}$)	1,040	781	862	704	1,226
pH	7.93	6.43	5.92	7.58	6.23
Turbidity (NTUs)	4.97	>200	12.0	2.61	>200

Definition(s):

$\mu\text{mhos/cm}$ - micromhos per centimeter

NTU - nephelometric turbidity unit

Note(s):

- ¹ - All field parameters were measured immediately prior to sampling.

Table 3
Metals in Groundwater
Fall 2005

EPA Methods SW6010B and SW7470A (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	Primary	3-MW-3 V3MW3F	3-MW-4 V3MW4F	3-MW-5 V3MW5F	3-MW-5 V99W577F (D)	3-MW-11 V3MW11F	3-MW-12A V3MW12AF
Dissolved Metals	MDL ¹	PQL ¹	MCL	BTW					
					11-Nov-05	14-Nov-05	14-Nov-05	11-Nov-05	15-Nov-05
Aluminum	15	60	1,000	1,200	60 U g	428 g	60 U g	60 U g	60 U g
Antimony ²	40	100	6	10	40 U g	40 U g	40 U g	40 U g	40 U g
Arsenic	4	10	7	52.1	5 U g	5 U g	5 U g	9.68 J q	5.34 J q
Barium	1	5	1,000	276	3.1 J q	17.6 g	85.7 g	87.7 g	6.77 g
Beryllium ²	1	5	4	0.3	1 U g	1 U g	1 U g	1 U g	1 U g
Cadmium	1	5	5	5	2 U g	2 U g	2 U g	2 U g	2 U g
Calcium	22	500	N/A	197,000	5,580 g	8,120 g	45,700 g	46,300 g	44,800 g
Chromium	1	10	50	20	5.65 J q	10.9 g	5 U g	5 U g	5 U g
Cobalt	2	15	N/A	13	5 U g	5 U g	5 U g	5 U g	5 U g
Copper	1	10	1,300	58	5.72 J q	477 g	57.400 g	58.000 g	58.60 g
Iron	4	100	N/A	3,530	53.6 J q	2 U g	2 U g	2 U g	582 g
Lead	2	3	15	3	2 U g	2 U g	2 U g	2 U g	2 U g
Magnesium	26	200	N/A	119,000	10,300 g	7,730 g	30,400 g	30,900 g	9,980 g
Manganese	1	5	N/A	971	26.1 g	21.7 g	811 g	832 g	29.8 g
Mercury	0.09	0.3	2	0.2	0.1 U g	0.1 U g	0.1 U g	0.1 U g	0.1 U g
Molybdenum	2	15	N/A	12	16.6 g	10.5 J q	10 U g	10 U g	10 U g
Nickel	5	20	100	490	157 g	132 g	10 U g	10.7 J q	166 g
Potassium	41	1,000	N/A	13,300	830 U g	830 U g	13400 g	13,000 g	830 U g
Selenium ²	5	10	50	3	7.12 J q	13.9 g	5 U g	5 U g	5 U g
Silver ²	1	10	N/A	0.2	5 U g	5 U g	5 U g	5 U g	5 U g
Sodium	23	500	N/A	420,000	254,000 g	181,000 g	91,200 g	93,900 g	246,000 g
Thallium ²	5	10	2	1	5 U g	5 U g	5 U g	5 U g	5 U g
Vanadium	1	10	N/A	28	52.9 g	5 U g	8.98 J q	7.49 J q	49.6 g
Zinc	2	20	N/A	80	7.18 BJ a, q	17.1 BJ k, q	137 g	150 g	6.58 BJ a, q

Table 3
Metals in Groundwater
Fall 2005

EPA Methods SW6010B and SW7470A ($\mu\text{g/L}$)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	3-MW-3 V3MW3	3-MW-4 V3MW4	3-MW-5 V3MW5	3-MW-57(D) V99W57(D)	3-MW-11 V3MW11	3-MW-12A V3MW12A
Sample ID	11-Nov-05	14-Nov-05	14-Nov-05	14-Nov-05	11-Nov-05	15-Nov-05
Collection Date						
Total Metals	MDL ¹	PQL ¹				
Aluminum	15	60	60 U g	12,800 g	318 g	289 g
Antimony	40	100	40 U g	40 U g	40 U g	40 U g
Arsenic	4	10	53.4 g	13.3 g	10.5 g	8.88 J q
Barium	1	5	17.6 g	90.4 g	92.3 g	92.6 g
Beryllium	1	5	1 U g	1 U g	1 U g	1 U g
Cadmium	1	5	2 U g	2 U g	2 U g	2 U g
Calcium	22	500	28,100 g	10,300 g	48,200 g	48,300 g
Chromium	1	10	5 U g	1,950 g	37.3 J f	72 J f
Cobalt	2	15	5 U g	13.6 J q	5 U g	5 U g
Copper	1	10	5 U g	88.8 g	11.6 J f	16 J f
Iron	4	100	6,830 g	30,400 g	61,200 g	62,600 g
Lead	2	3	2 U g	12 g	5.01 g	2.83 J q
Magnesium	26	200	23,200 g	10,500 g	31,800 g	31,800 g
Manganese	1	5	73 g	180 g	853 g	863 g
Mercury	0.09	0.3	0.1 U g	0.239 J q	0.1 U g	0.1 U g
Molybdenum	2	15	10 U g	40.7 g	10 U g	10 U g
Nickel	5	20	10 U g	286 g	13.4 J q	26.7 g
Potassium	41	1,000	2,110 g	2,350 g	13,000 g	13,900 g
Selenium	5	10	5.61 J q	14.2 g	5 U g	5 U g
Silver	1	10	5 U g	5 U g	5 U g	5 U g
Sodium	23	500	136,000 g	182,000 g	93,300 g	93,000 g
Thallium	5	10	5 U g	5 U g	7.84 J q	5.5 J q
Vanadium	1	10	6.42 J q	45.8 g	9.58 J q	8.79 J q
Zinc	2	20	7.71 B J a, q	33.5 g	397 g	359 g

Table 3
Metals in Groundwater
Fall 2005
EPA Methods SW6010B and SW7470A ($\mu\text{g/L}$)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Data Validity Qualifier(s):	B	- The sample result is less than 5 times (10 times for common organic laboratory contaminants) the blank contamination. The result is considered not to have originated from the environmental sample, because cross-contamination is suspected.
	J	- The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.
	U	- The analyte was not detected at or above the MDL.
Data Validity Comment(s):		
<p>a - The analyte was found in the method blank.</p> <p>f - The duplicate/replicate sample's relative percent difference was outside the control limit.</p> <p>g - The data met prescribed criteria as detailed in the QAPP.</p> <p>k - The analyte was found in a field blank.</p> <p>q - The analyte detection was below the PQL.</p>		
Definition(s):		
<p>BT - background threshold value</p> <p>(D) - duplicate sample</p> <p>MCL - maximum contaminant level</p> <p>MDL - method detection limit</p> <p>$\mu\text{g/L}$ - micrograms per liter</p> <p>PQL - practical quantitation limit</p> <p>QAPP - Quality Assurance Project Plan</p>		
Note(s):		
<p>Bold type indicates results that were above the MCL.</p> <p>Shading indicates results that were above the 95th percentile BT.</p> <p>1 - Values from QAPP Addendum (Tetra Tech 2004).</p> <p>2 - The BT was less than the detection limit for this metal.</p>		

Table 4
Hexavalent Chromium in Groundwater
Fall 2005
EPA Method E218.6 (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	Hexavalent Chromium
			MDL¹ 0.1
			PQL¹ 0.2
3-MW-5	V3MW5M	14-Nov-05	0.1 UJ c
3-MW-5	V99W577 (D)	14-Nov-05	0.1 UJ c

Data Validity Qualifier(s):

- UJ - The analyte was not detected above the MDL; however, the MDL is uncertain and may be elevated above normal levels.

Data Validity Comment(s):

- c - The matrix spike and/or matrix spike duplicate recoveries were outside control limits.

Definitions(s):

- (D) - duplicate sample
- MDL - method detection limit
- µg/L - micrograms per liter
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan

Note(s):

- 1 - Values from QAPP Addendum (Tetra Tech 2004).

Table 5
TPH as Diesel and PAHs in Groundwater
Fall 2005
EPA Methods SW8015B and SW8270C SIM
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	TPH (mg/L)		PAHs ($\mu\text{g}/\text{L}$)		
			TPH as diesel		Fluorene	Naphthalene	All other target analytes
			MDL ¹	0.19			
			PQL ¹	1.0	2.0	1.0	N/A
3-MW-5	V3MW5M	14-Nov-05	4.2	g	0.85 J q	0.41 U g	ND
3-MW-5	V99W577 (D)	14-Nov-05	5.6	g	1.1 J q	0.41 U g	ND
3-MW-11	V3MW11	11-Nov-05	6.7	g	NA	NA	NA
3-MW-12A	V3MW12A	15-Nov-05	2.1	g	0.19 U g	0.32 J q	ND

Data Validity Qualifier(s):

- J - The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.
- U - The analyte was not detected at or above the MDL.

Data Validity Comment(s):

- g - The data met prescribed criteria as detailed in the QAPP.
- q - The analyte detection was below the PQL.

Definition(s):

- (D) - duplicate sample
- MDL - method detection limit
- $\mu\text{g}/\text{L}$ - micrograms per liter
- mg/L - milligrams per liter
- N/A - not applicable
- NA - not analyzed
- ND - not detected; result is less than the MDL
- PAH - polynuclear aromatic hydrocarbon
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan
- SIM - selected ion monitoring
- TPH - total petroleum hydrocarbons

Note(s):

The Vandenberg AFB leaking underground fuel tank action level for groundwater is 1 mg/L.

- 1 - Values from QAPP Addendum (Tetra Tech 2004).

Table 6
VOCs in Groundwater
Fall 2005
EPA Method SW8460B ($\mu\text{g/L}$)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	3-MW-3		3-MW-4		3-MW-5		3-MW-5		3-MW-11		3-MW-12A	
		V3MW3	11-Nov-05	V3MW4	14-Nov-05	V3MW5M	14-Nov-05	V99W577 (D)	14-Nov-05	V3MW11	11-Nov-05	V3MW11	15-Nov-05
Collection Date		Primary	MCL ¹	PQL ¹	MDL ¹								
1,1-DCE	0.32	1.0	6	0.2	U g	0.29	J q	0.2	U g	0.2	U g	0.2	U g
1,4-DCB	0.11	1.0	5	0.2	U g	0.2	U g	8	g	9	g	0.2	U g
Acetone	0.78	10	N/A	5	U g	5	U g	5	U g	5	U g	0.2	U g
Benzene	0.07	0.4	1	0.2	U g	0.2	U g	0.36	J q	0.41	g	0.2	U g
Chlorobenzene	0.12	0.5	70	0.2	UJ c	0.2	UJ c	13	J c	15	J c	0.2	UJ c
Chloroform	0.12	0.3	100 ²	0.2	U g	1.1	g	0.2	U g	0.2	U g	0.2	U g
cis-1,2-DCE	0.21	1.0	6	0.2	U g	66	g	0.2	U g	0.2	U g	7.2	g
PCE	0.15	1.0	5	10	g	0.2	U g	0.2	U g	0.2	U g	0.2	U g
trans-1,2-DCE	0.27	1.0	10	0.2	U g	1.2	g	0.2	U g	0.2	U g	0.2	U g
TCE	0.18	1.0	5	0.44	J q	230	g	0.59	J q	0.56	J q	24	g
Vinyl chloride	0.36	1.0	0.5	0.2	U g	0.2	U g	0.2	U g	0.91	J q	17	g
All other target analytes	N/A	N/A	N/A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Data Validity Qualifier(s):

- J - The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.
- U - The analyte was not detected at or above the MDL.
- UJ - The analyte was not detected above the MDL; however, the MDL is uncertain and may be elevated above normal levels.
- C - The matrix spike and/or matrix duplicate recoveries were outside control limits.
- G - The data met prescribed criteria as detailed in the QAPP.
- Q - The analyte detection was below the PQL.

Data Validity Comment(s):

- C - The matrix spike and/or matrix duplicate recoveries were outside control limits.
- G - The data met prescribed criteria as detailed in the QAPP.
- Q - The analyte detection was below the PQL.

Definition(s):

- (D) - duplicate sample
- DCB - dichlorobenzene
- DCE - dichloroethene
- MCL - maximum contaminant level
- MDL - method detection limit
- $\mu\text{g/L}$ - micrograms per liter
- N/A - not applicable
- ND - not detected; result is less than the MDL
- PCE - tetrachloroethene
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan
- TCE - trichloroethene

Note(s):

- 1 Bold type indicates results that were above the MCL.
- 2 Values from QAPP Addendum (Tetra Tech 2004).
- For total trihalomethanes (sum of bromodichloromethane, chloroform, and dibromochloromethane).

Table 7
1,4-Dioxane in Groundwater
Fall 2005
EPA Method SW8270C (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	1,4-Dioxane		
			MDL¹	0.5	
			PQL¹	3.0	
3-MW-5	V3MW5M	14-Nov-05	0.63	U	g
3-MW-5	V99W577 (D)	14-Nov-05	0.62	U	g

Data Validity Qualifier(s):

U - The analyte was not detected at or above the MDL.

Data Validity Comment(s):

g - The data met prescribed criteria as detailed in the QAPP.

Definition(s):

- (D) - duplicate sample
- MDL - method detection limit
- µg/L - micrograms per liter
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan

Note(s):

- 1 - Values from QAPP Addendum (Tetra Tech 2004).

Table 8
Summary of Key Contaminants of Concern
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	PCE ^a (µg/L)					Spr-05	Spr-05	Fall-05
								Fall-01	Spr-02	Fall-02	Spr-03	Fall-03			
3-MW-3	1.5	1.5	2.4	ND	2.3	3.1	1.0	4.4	5.6	5.4	8.56	7.30	7.9	7.3	NA
3-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-MW-10	DRY	ND	ND	ND	ND	ND	ND	DRY	ND	DRY	DRY	DRY	NA	ND	DRY
3-MW-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
3-MW-12A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
3-SP-1	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	ND	DRY
3-SP-2	DRY	ND	DRY	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
<hr/>															
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	TCE ^b (µg/L)					Spr-05	Spr-05	Fall-05
								Fall-01	Spr-02	Fall-02	Spr-03	Fall-03	Spr-04	Fall-04	Win-05
3-MW-3	ND	0.81	ND	ND	ND	ND	ND	ND	ND	ND	0.35	0.38	0.37	0.38	NA
3-MW-4	260	120	200	130	200	67	260	93	70	180	200	215	56	110	NA
3-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11	NA	ND
3-MW-10	DRY	13	14	4.3	0.6	ND	5.2	ND	DRY	ND	DRY	DRY	DRY	NA	ND
3-MW-11	7.6	4.3	56	27	17	11	63	38	100	140	97.8	111	100	23	NA
3-MW-12A	0.78	450	260	130	210	180	110	100	110	15	681	183	83	21	NA
3-SP-1	DRY	0.82	DRY	DRY	DRY	43	DRY	DRY	DRY	DRY	DRY	DRY	DRY	ND	DRY
3-SP-2	DRY	ND	DRY	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
<hr/>															
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	cis-1,2-DCE ^c (µg/L)					Spr-05	Spr-05	Fall-05
								Fall-01	Spr-02	Fall-02	Spr-03	Fall-03	Spr-04	Fall-04	Win-05
3-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-MW-4	130	19	18	36	86	8.1	28	11	4.8	61	46.2	82.9	8.7	50	NA
3-MW-5	ND	ND	ND	ND	ND	0.8	0.6	ND	ND	3.3	0.12	ND	0.31	0.67	NA
3-MW-10	DRY	15	25	0.74	ND	6.1	ND	18	DRY	ND	DRY	DRY	DRY	NA	ND
3-MW-11	7.1	4.8	5	4.3	6.6	4.7	2.9	6.4	8.1	17	55.6	37.4	15	31	NA
3-MW-12A	2.2	170	230	120	260	140	240	210	130	340	321	380	14	NA	1.2
3-SP-1	DRY	1.9	DRY	DRY	DRY	45	DRY	DRY	DRY	DRY	DRY	DRY	DRY	ND	DRY
3-SP-2	DRY	ND	DRY	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Table 8
Summary of Key Contaminants of Concern
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

<i>trans</i> -1,2-DCE ^d (µg/L)																	
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	Fall-01	Spr-02	Fall-02	Spr-03	Fall-03	Spr-04	Fall-04	Win-05	Spr-05	Fall-05
3-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	
3-MW-4	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.5	0.86	1.31	ND	ND	0.26	1.2
3-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
3-MW-10	DRY	ND	ND	ND	ND	ND	ND	ND	DRY	ND	0.35	0.29	0.23	0.24	NA	ND	DRY
3-MW-11	ND	ND	ND	ND	ND	ND	ND	ND	DRY	DRY	ND	ND	ND	ND	ND	ND	DRY
3-MW-12A	1.5	2.3	13.0	78	42	6.8	21	89	18	120	30.1	258	29	5.5	NA	5.7	2.1
3-SP-1	DRY	ND	DRY	DRY	DRY	0.54	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	ND	DRY	DRY
3-SP-2	DRY	ND	DRY	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Vinyl chloride ^e (µg/L)																	
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	Fall-01	Spr-02	Fall-02	Spr-03	Fall-03	Spr-04	Fall-04	Win-05	Spr-05	Fall-05
3-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
3-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-MW-10	DRY	ND	ND	ND	ND	ND	ND	ND	DRY	ND	DRY	DRY	DRY	DRY	NA	ND	DRY
3-MW-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	36	NA	0.67	0.91
3-MW-12A	5.6	ND	47	60	51	18	78	110	81	82	82.9	136	68	28	NA	19	17
3-SP-1	DRY	ND	DRY	DRY	DRY	0.64	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	ND	DRY	DRY
3-SP-2	DRY	ND	DRY	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Benzene ^f (µg/L)																	
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	Fall-01	Spr-02	Fall-02	Spr-03	Fall-03	Spr-04	Fall-04	Win-05	Spr-05	Fall-05
3-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.42	ND	ND	ND	NA	ND	ND
3-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.22	ND	ND	ND	NA	ND	ND
3-MW-5	ND	ND	2.5	0.56	1.0	1.7	ND	ND	ND	DRY	0.80	0.30 ^b	ND	0.2	NA	1.4	0.41
3-MW-10	DRY	ND	ND	ND	ND	ND	ND	2.1	ND	DRY	DRY	DRY	DRY	NA	ND	DRY	DRY
3-MW-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.14	ND	ND	NA	ND	ND
3-MW-12A	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	0.37	ND	ND	ND	NA	0.46	ND
3-SP-1	DRY	ND	DRY	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	ND	DRY	DRY
3-SP-2	DRY	ND	DRY	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Table 8
Summary of Key Contaminants of Concern
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

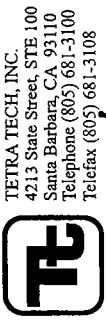
	1,4-Dichlorobenzene ^a (µg/L)											
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	Fall-01	Spr-02	Fall-02	Spr-03	Fall-03
3-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-MW-5	8.2	ND	ND	18	12	6.6	13	7.7	7.0	4.9	9.94	5.20
3-MW-10	DRY	ND	ND	ND	ND	ND	ND	DRY	ND	DRY	DRY	NA
3-MW-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	DRY
3-MW-12A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-SP-1	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	ND
3-SP-2	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
TPH as Diesel (mg/L)												
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	Fall-01	Spr-02	Fall-02	Spr-03	Fall-03
3-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
3-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA
3-MW-5	0.73	ND	ND	ND	ND	ND	ND	0.55	ND	0.60	1.3	3.8
3-MW-10	DRY	ND	ND	ND	ND	ND	ND	DRY	ND	0.30	DRY	DRY
3-MW-11	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	1.3
3-MW-12A	ND	ND	0.57	1.2	ND	0.66	1.2	0.93	0.82	0.90	1.11	1.3
3-SP-1	DRY	ND	DRY	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	ND
3-SP-2	DRY	ND	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY

Definition(s):

- DCE - dichloroethene
 - DRY - well was dry or had insufficient water for sampling
 - µg/L - micrograms per liter
 - mg/L - milligrams per liter
 - MCL - maximum contaminant level
 - NA - not analyzed
 - N/A - not applicable
 - ND - not detected; result is less than the method detection limit
 - PCE - tetrachloroethene
 - TCE - trichloroethene
 - TPHd - total petroleum hydrocarbons as diesel
 - VAFB - Vandenberg Air Force Base
- ^a Bold type indicates results that were above the MCL.
The Vandenberg AFB leaking underground fuel tank action level for TPH in groundwater is 1 mg/L.
- ^b The MCL for PCE is 5 µg/L.
- ^c The MCL for TCE is 5 µg/L.
- ^d The MCL for *cis*-1,2-DCE is 6 µg/L.
- ^e The MCL for *trans*-1,2-DCE is 10 µg/L.
- ^f The MCL for vinyl chloride is 0.5 µg/L.
- ^g The MCL for benzene is 1 µg/L.
- ^h Suspected false positive. The data were qualified for blank contamination. The compound was detected in the blank within the same order of magnitude as the sample result.

APPENDIX A

PURGE RECORDS



GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

Page 1 of 1

4213 State Street, STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 661-3108

DATE 11/11/05 **SITE NUMBER** 3 **TRIP BLANK ID.** V3TB1121
PROGRAM NAME BG-m8 **MONITORING WELL IDENTIFICATION** 3-MW-3
SAMPLE I.D. V3mws3 **DUPLICATE I.D./COLLECTION TIME** -/-
STATIC WATER LEVEL (ft btoc) 16.89 **TOTAL WELL DEPTH (ft btoc)** 25.5
WATER COLUMN (feet) 8.6 **TUBING DIAMETER (in)** 3.60
PUMP & TUBING (V) (L) 0.72 **5 V (L)** 3.60

PURGING DEVICE MICROPURGE DEDICATED PUMP **SAMPLING DEVICE** MICROPURGE DEDICATED PUMP
PID READING IN CASING (ppm) (initial) - - - (vented to) - - -
PID READING IN BREATHING ZONE (ppm) (initial) - - - (vented to) - - -

Print Date

Time	Activity	Water Level (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (L)	Pump & Tubing Volumes Purged	Flow Rate (LPM)
1139	Arrived at well											
1143	Begin Purge											
1145		17.03	18.8	966	7.69	5.55	2.43	-16.7	Clear	0.36	0.5	1
1147		17.08	18.93	1023	7.73	7.19	1.99	-9.6	Clear	0.72	1.0	
1149		17.10	18.95	1031	7.74	6.84	1.88	-20.5	Clear	1.08	1.5	
1151		17.11	18.97	1034	7.78	6.24	1.67	-23.3	Clear	1.44	2.0	
1153		17.13	18.86	1035	7.82	5.35	1.56	-26.8	Clear	1.80	2.5	
1155		17.14	18.92	1036	7.83	5.51	1.48	-28.1	Clear	2.16	3.0	
1157		17.18	19.06	1038	7.91	5.43	1.34	-32.1	Clear	2.52	3.5	
1159	End Purge	17.24	19.10	1040	7.93	4.97	1.31	-33.5	Clear	2.88	4.0	X
1210	Sample	17.28										
1225	Vacated well											

Fe-2 (ppm) - **Taken immediately before sampling.**
WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 17.28 **FILTER LOT #** A1125464
Comments: _____

X:VLRP_DriverField_Workfield_CoordinationFormsTool42.Field Data Log Sheet.MP.xls.mn
 PID READING IN BREATHING ZONE (ppm) (initial) _____ (vented to) _____

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.



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GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

Page 1 of 1

DATE 11/11/05 SITE NUMBER 3
PROGRAM NAME B6m P TRIP BLANK I.D. 13TBH25
MONITORING WELL IDENTIFICATION 3-m104
SAMPLE I.D. V3mwy DUPLICATE I.D. / COLLECTION TIME —
STATIC WATER LEVEL (ft btoc) 11.70 TOTAL WELL DEPTH (ft btoc) 14.5
WATER COLUMN (feet) 2.8 CASTING DIAMETER (in) 4
WELL VOLUME (Y) (gals) 1.82 3 V (gals) 5.46 BAILER BOX # 190

Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (gals)	Well Volumes Purged	Flow Rate (GPM)
<u>9:00</u>	Arrived at well	—	—	—	—	—	—	—	—	—	—	—	—
<u>9:09</u>	Begin Purge	—	—	—	—	—	—	—	—	—	—	—	—
<u>9:13</u>	well purged dry prior to first reading	—	—	—	—	—	—	—	—	—	—	—	—
<u>11:45</u>	Sampled	<u>13.31</u>	—	<u>18.97</u>	<u>7.81</u>	<u>6.43</u>	<u>200</u>	<u>3.97</u>	<u>13.5</u>	<u>brown</u>	—	—	—
<u>11:55</u>	Vacated well	—	—	—	—	—	—	—	—	—	—	—	—

Fe+2 (ppm) — Taken from first bailer immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 13.31 FILTER LOT #: A10314700

Comments: —

PARAMETERS FOR WATER QUALITY STABILIZATION			
Temperature	± 1 C (1.8 F)	Conductivity	$\pm 5\%$
pH	± 0.1	Turbidity	5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.



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GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

DATE 11/14/05

PROGRAM NAME B & M0

MONITORING WELL IDENTIFICATION 3-mw-5

SAMPLE I.D. V3mw5m DUPLICATE I.D. / COLLECTION TIME U99W577

STATIC WATER LEVEL (ft btoc) 13.15 TOTAL WELL DEPTH (ft btoc) 27.2

WATER COLUMN (feet) 14.1 CASTING DIAMETER (in) 4

WELL VOLUME (V) (gal) 9.17 3 V (gal) 21.50 BAILER BOX # 196

		PURGING DEVICE		2" SUBMERSIBLE GRUNDfos PUMP	
		SAMPLING DEVICE		DISPOSABLE TEFLON BAILER	
		PID READING IN CASING (ppm)	(initial)	<u>ND</u>	(vented to) <u>200</u>
		PID READING IN BREATHING ZONE (ppm)	(initial)	<u>ND</u>	(vented to) <u>—</u>
		SAMPLER'S SIGNATURE		<u>C. Schaefer</u>	
Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	EC (µhos/cm) (Deg. C)	pH
<u>940</u>	Arrived at well	—	—	—	—
<u>952</u>	Begin Purge	<u>27</u>	—	—	—
<u>957</u>		<u>17.70</u>	<u>27</u>	<u>893</u>	<u>600</u>
<u>1002</u>		<u>22.02</u>	<u>27</u>	<u>863</u>	<u>5.92</u>
<u>1006</u>	well purged dry	—	—	—	—
<u>1040</u>	sample well <u>20.93</u>	—	<u>16.82</u>	<u>907</u>	<u>6.57</u>
<u>1045</u>	filled sample	—	—	—	—
	1600 dry sample	—	—	—	—
	1605 dry filled sample	—	—	—	—
<u>1135</u>	Vacated well	—	—	—	—

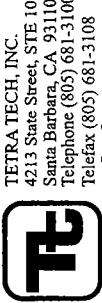
Fe+2 (ppm) — Taken from first bailer immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 20.16 FILTER LOT # A10314700

Comments: —

PARAMETERS FOR WATER QUALITY STABILIZATION			
Temperature	± 1 C (1.8 F)	Conductivity	$\pm 5\%$
pH	± 0.1	Turbidity	5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.



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GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

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DATE 11/11/05 SITE NUMBER 3
PROGRAM NAME B-Cmp TRIP BLANK I.D. V3TB1121
MONITORING WELL IDENTIFICATION 3-MW-11
SAMPLE I.D. V3Mw11 DUPLICATE I.D./ COLLECTION TIME -
STATIC WATER LEVEL (ft btoc) 23.45 TOTAL WELL DEPTH (ft btoc) 40.4
WATER COLUMN (feet) 17.0 TUBING DIAMETER (in) 0.86

PUMP & TUBING (Y) (L)		5 V (L)		4.3		SAMPLER'S SIGNATURE		MICROPURGE DEDICATED PUMP				
Time	Activity	Water Level (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (L)	Pump Tubing Volumes Purged	Flow Rate (LPM)
1054	Arrived at well	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
1056	Begin Purge	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	0.18
1059		<u>23.61</u>	<u>18.06</u>	<u>717</u>	<u>7.53</u>	<u>5.21</u>	<u>1.00</u>	<u>7.0</u>	<u>clear</u>	<u>0.36</u>	<u>0.42</u>	
1100		<u>23.67</u>	<u>18.05</u>	<u>707</u>	<u>7.56</u>	<u>2.36</u>	<u>1.56</u>	<u>1.4</u>		<u>0.72</u>	<u>0.84</u>	
1102		<u>23.72</u>	<u>18.01</u>	<u>704</u>	<u>7.58</u>	<u>2.61</u>	<u>1.38</u>	<u>-2.3</u>	<u>↓</u>	<u>1.68</u>	<u>1.25</u>	
1103	End Purge	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
1115	Sample	<u>23.73</u>	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____
1135	Vacated well	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____	_____

F+2 (ppm) - Taken immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 23.73 FILTER LOT # Alo4 25964

Comments:

PARAMETERS FOR WATER QUALITY STABILIZATION		
Temperature	<u>+1</u> C (1.8 F)	Conductivity $\pm 5\%$
pH	<u>± 0.1</u>	Turbidity 5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.



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GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

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Page

DATE	<u>11/15/05</u>	SITE NUMBER	<u>3</u>	PURGING DEVICE	2" SUBMERSIBLE GRUNDFOS PUMP							
PROGRAM NAME	<u>36m0</u>	TRIP BLANK I.D.	<u>V3T81128</u>	SAMPLING DEVICE	DISPOSABLE TEFILON BAILER							
MONITORING WELL IDENTIFICATION	<u>3-mw-12A</u>	DUPLICATE I.D. / COLLECTION TIME	<u>—</u>	PID READING IN CASING (ppm)	(initial) <u>ND</u>	(vented to) <u>—</u>	(vented to) <u>—</u>					
SAMPLE I.D.	<u>J3mw12A</u>	STATIC WATER LEVEL (ft btoc)	<u>10.39</u>	PID READING IN BREATHING ZONE (ppm)	(initial) <u>ND</u>	(vented to) <u>—</u>	(vented to) <u>—</u>					
WATER COLUMN (feet)	<u>2.8</u>	TOTAL WELL DEPTH (ft btoc)	<u>13.2</u>	SAMPLER'S SIGNATURE <u>S. Phinot</u>								
WELL VOLUME (Y) (gals)	<u>1.83</u>	CASING DIAMETER (in)	<u>5.48</u>	BAILER BOX #	<u>196</u>							
Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (gals)	Well Volumes Purged	Flow Rate (GPM)
840	Arrived at well	—	—	—	—	—	—	—	—	—	—	—
653	Begin Purge	—	<u>13</u>	—	—	—	—	—	—	—	—	<u>0.5</u>
857	well purged dry prior to first reading	—	—	—	—	—	—	—	—	—	—	—
1420	sample well 1040 —	<u>19.10</u>	<u>1226</u>	<u>6.23</u>	<u>100</u>	<u>1.79</u>	<u>-17.2</u>	<u>brown</u>	—	—	—	—
1425	Silvertop sample	—	—	—	—	—	—	—	—	—	—	—
1440	Vacated well	—	—	—	—	—	—	—	—	—	—	—

Fe+2 (ppm) — Taken from first bailer immediately before sampling

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 10.83 FILTER LOT # A10314700

Comments: —

PARAMETERS FOR WATER QUALITY STABILIZATION			
Temperature $\pm 1^\circ\text{C}$ (1.8 F)	Conductivity $\pm 5\%$	pH ± 0.1	Turbidity 5 NTUS

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.



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GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

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DATE 11/15/05

SITE NUMBER 3

PURGING DEVICE

2" SUBMERSIBLE GRUNDfos PUMP

PROGRAM NAME B6m0

TRIP BLANK I.D. 3333 V31 81128

SAMPLING DEVICE

DISPOSABLE TEFLON BAILER

MONITORING WELL IDENTIFICATION 3-MW-123

DUPLICATE I.D. / COLLECTION TIME —

PID READING IN CASING (ppm)

(initial) 4.9

(vented to) ND

SAMPLE I.D. —

TOTAL WELL DEPTH (ft btoc) 33.3

PID READING IN BREATHING ZONE (ppm)

(initial) ND

(vented to) ND

STATIC WATER LEVEL (ft btoc) 33.87

CASING DIAMETER (in) 0.4

SAMPLER'S SIGNATURE S. John Fair Jr.

WATER COLUMN (feet) 0.28

3 V(gals) 0.81

BAILER BOX # —

WELL VOLUME (V) (gals)

3 V(gals)

CASTING DIAMETER (in) 0.81

BAILER BOX # —

PURGING DEVICE

2" SUBMERSIBLE GRUNDfos PUMP

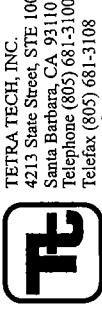
SAMPLING DEVICE

DISPOSABLE TEFLON BAILER

(initial) 4.9

(vented to) ND

(vented to) <u



TETRA TECH, INC.
4213 State Street, STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

Page 1 of 1

DATE 11/15/05 SITE NUMBER 3
PROGRAM NAME B6mp TRIP BLANK I.D. V3T81128
MONITORING WELL IDENTIFICATION 3-mw - 12.D
SAMPLE I.D. — DUPLICATE I.D. / COLLECTION TIME —
STATIC WATER LEVEL (ft btoc) 53.9 TOTAL WELL DEPTH (ft btoc) 54.3
WATER COLUMN (feet) 0.4 Casing Diameter (in) 4
WELL VOLUME (V) (gals) 0.25 3 V (gals) 0.75 BAILER BOX # —

Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (gals)	Well Volumes Purged	Flow Rate (GPM)
<u>840</u>	Arrived at well	—	—	—	—	—	—	—	—	—	—	—	—
<u>—</u>	Begin Purge	—	—	—	—	—	—	—	—	—	—	—	—
<i>insufficient water for purging + sampling - no sample collected</i>													
<u>850</u>	Vacated well	—	—	—	—	—	—	—	—	—	—	—	—

Fer-2 (ppm) — Taken from first bailer immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: — FILTER LOT #: —

Comments:

X:JLRP_DriverField_Workfield_CoordinatesOrMSITool030_PrelData_Log_Sheet_Groundwater_mit
[initial] 0.4 (vented to) 40
PID READING IN CASING (ppm) [initial] NO (vented to) NO
PID READING IN BREATHING ZONE (ppm) [initial] —

[initial] — (vented to) —
SAMPLER'S SIGNATURE J. M. Farley

PARAMETERS FOR WATER QUALITY STABILIZATION
[Temperature $\pm 1^\circ\text{C}$ (1.8 F) Conductivity $\pm 5\%$
pH ± 0.1 Turbidity 5 NTUs]

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.



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4213 State Street, STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

NOV. 14, 2005

DATE SITE NUMBER **3**

PROGRAM NAME **96MP**

TRIP BLANK I.D. **—**

MONITORING WELL IDENTIFICATION **V3SP1**

DUPPLICATE I.D. / COLLECTION TIME **3-SP-1**

PID READING IN CASING (ppm) **—**

SAMPLING DEVICE **DISPOSABLE TEFILON BAILER**

SAMPLE I.D. **—**

TOTAL WELL DEPTH (ft btoc) **—**

(vented to) **—**

STATIC WATER LEVEL (ft btoc) **—**

CASING DIAMETER (in) **—**

(vented to) **—**

WATER COLUMN (feet) **—**

CASING DIAMETER (in) **—**

(vented to) **—**

WELL VOLUME (V) (gals) **—**

BAILER BOX # **—**

(vented to) **—**

3 V (gals) **—**

BAILER BOX # **—**

(vented to) **—**

Time Activity Water Level Pump Depth Temp EC pH Turbidity Dissolved Oxygen (mg/L) ORP (mV) Color Volume Purged (gals) Well Volumes Purged Flow Rate (GPM)

1145 Arrived at well **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—**

— Begin Purge **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—**

— DRY. NO SAMPLE. **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—**

1155 Vacated well **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—** **—**

— Taken from first bailer immediately before sampling.

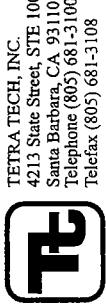
WATER LEVEL (ft btoc) AT TIME OF SAMPLING: **—** FILTER LOT #: **—**

Comments: _____

2" SUBMERSIBLE GRUNDFOS PUMP									
PURGING DEVICE	—	—	—	—	—	—	—	—	—
SAMPLING DEVICE	—	—	—	—	—	—	—	—	—
PID READING IN CASING (ppm)	—	—	—	—	—	—	—	—	—
PID READING IN BREATHING ZONE (ppm)	—	—	—	—	—	—	—	—	—
SAMPLER'S SIGNATURE	<i>See Note</i>	<i>See Note</i>	<i>See Note</i>	<i>See Note</i>	<i>See Note</i>	<i>See Note</i>	<i>See Note</i>	<i>See Note</i>	<i>See Note</i>
Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)
1145	Arrived at well	—	—	—	—	—	—	—	—
—	Begin Purge	—	—	—	—	—	—	—	—
—	DRY. NO SAMPLE.	—	—	—	—	—	—	—	—
1155	Vacated well	—	—	—	—	—	—	—	—

PARAMETERS FOR WATER QUALITY STABILIZATION			
Temperature	± 1 C (1.8 F)	Conductivity	$\pm 5\%$
pH	± 0.1	Turbidity	5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.



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GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING

Page 1 of 1

DATE Nov. 14, 2005

PROGRAM NAME B6MP

MONITORING WELL IDENTIFICATION 3 - SP - 2

SAMPLE I.D. V3SP2

STATIC WATER LEVEL (ft btoc) -

WATER COLUMN (feet) -

WELL VOLUME (V) (gals) -

SITE NUMBER 3

TRIP BLANK I.D.

DUPLICATE I.D. / COLLECTION TIME - / -

TOTAL WELL DEPTH (ft btoc) -

CASING DIAMETER (in) -

3 V (gals) -

BAILER BOX # -

PURGING DEVICE

SAMPLING DEVICE

PID READING IN CASING (ppm)

PID READING IN BREATHING ZONE (ppm)

(initial) (vented to)

(initial) (vented to)

SAMPLER'S SIGNATURE *Bob Gossage*

DISPOSABLE TEFLON BAILER

Time	Activity	Water Level (ft btoc)	Pump Depth (ft btoc)	Temp (Deg. C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (gals)	Well Volumes Purged	Flow Rate (GPM)
1115	Arrived at well	—	—	—	—	—	—	—	—	—	—	—	—
—	Begin Purge	—	—	—	—	—	—	—	—	—	—	—	—
—	DRY. NO SAMPLE.	—	—	—	—	—	—	—	—	—	—	—	—
1130	Vacated well	—	—	—	—	—	—	—	—	—	—	—	—

Fe+2 (ppm) Taken from first bailer immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING:

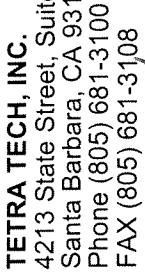
Comments: _____

X:\JR\DriveField\Workfield\Coordination\forms\ST0050.Prel-Data-Log-Sheet-Grundfos.ai.mh

Temperature $\pm 1^\circ \text{C}$ (1.8 F)	Conductivity $\pm 5\%$
pH ± 0.1	Turbidity 5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities.

APPENDIX B**CHAIN-OF-CUSTODY RECORDS**



SHIPPED TO: EMAX Labs

4213 State Street, Suite 100
Santa Barbara, CA 93110
Phone (805) 681-3100
FAX (805) 681-3108

1835 West 205th Street
Torrance, CA 90501

TETRA TECH, INC.
CHAIN OF CUSTODY RECORD

A2/Env-17

CLIENT	Vandenberg AFB	ANALYTICAL METHODS		NUMBER OF CONTAINERS	CONTAINER TYPE	MATRIX TYPE	NUMBER OF SAMPLES	FILTERED SAMPLE	OBSERVATIONS/COMMENTS:	TURN-AROUND TIME:
		SITE	DATE							
PROJECT NAME	BGMP									Standard
PROJECT MANAGER	Kevin McNamara									
TC#	T99105-06									
SAMPLERS (Signatures)										
		SAMPLE NO.	DATE	TIME						
1. V3MW12A		11/15/05	1420		X					
2. V3MW12AF		11/15/05	1415		X					
3. V3TB12B		11/15/05	800		X					
MATRIX	S = Soil W = Water SD = Sediment	CONTAINER TYPE:	G = Glass SS = Stainless Steel P = Plastic	PRESERVATIVES:						
TYPE:	E = Encore	COMPANY:	EMAY	All samples are preserved at 4°C. Water samples are preserved as indicated on the sample labels.	DATE:	11/16/05	TIME:	1005	TOTAL NUMBER OF CONTAINERS:	10
REINQUISITIONED BY:	SIGNATURE:	TETRA TECH, INC.							METHOD OF SHIPMENT	
RECEIVED BY:	George Lim	COMPANY: EMAY							TEMPERATURE:	BLANK
REINQUISITIONED BY:	SIGNATURE:	COMPANY: EMAY							EACH COOLER:	YES NO
RECEIVED BY:	George Lim	COMPANY: EMAY							SPECIAL SHIPMENT/HANDLING/STORAGE REQUIREMENTS:	

T = 3.5 °C

APPENDIX C

SUPPORTING DATA

Table C-1
Summary of Arsenic, Antimony, and Cadmium Historic Concentrations (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

	Arsenic ^a												Antimony ^b												Cadmium ^c											
	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	Fall-01	Spr-02	Fall-02	Spr-03	Fall-03	Spr-04	Fall-04	Spr-05	Win-05	Spr-05	Fall-05	Fall-99	Win-00	Spr-00	Sum-00	Fall-00	Win-01	Spr-01	Fall-01	Spr-02	Fall-02	Spr-03	Fall-03	Spr-04	Fall-04	Spr-05	Win-05	Spr-05	Fall-05
3-MW-3	44.6	41.4	44.9	39.8	43.1	39	42.5	51.5	36.6	35.9	26.2	36.9	45.8	53.4	NA	45.6	52.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
3-MW-4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND				
3-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND				
3-MW-10	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY					
3-MW-11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND				
3-MW-12A	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND				
3-SP-1	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY					
3-SP-2	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY					

Definition(s):

- DRY - well was dry or had insufficient water for sampling
- µg/L - micrograms per liter
- MCL - maximum contaminant level
- NA - not analyzed
- N/A - not applicable
- ND - not detected; result is less than the method detection limit
- VAFB - Vandenberg Air Force Base

Note(s):

- Bold type indicates results that were above the MCL.
- Shading indicates results that were above the 95th percentile BTv.
- ^a - The BTv and MCL for arsenic are 7 and 10 µg/L, respectively.
- ^b - The BTv and MCL for antimony are 10 and 6 µg/L, respectively.
- ^c - The BTv and MCL for cadmium are both 5 µg/L.
- ^d - Qualified due to method blank contamination.

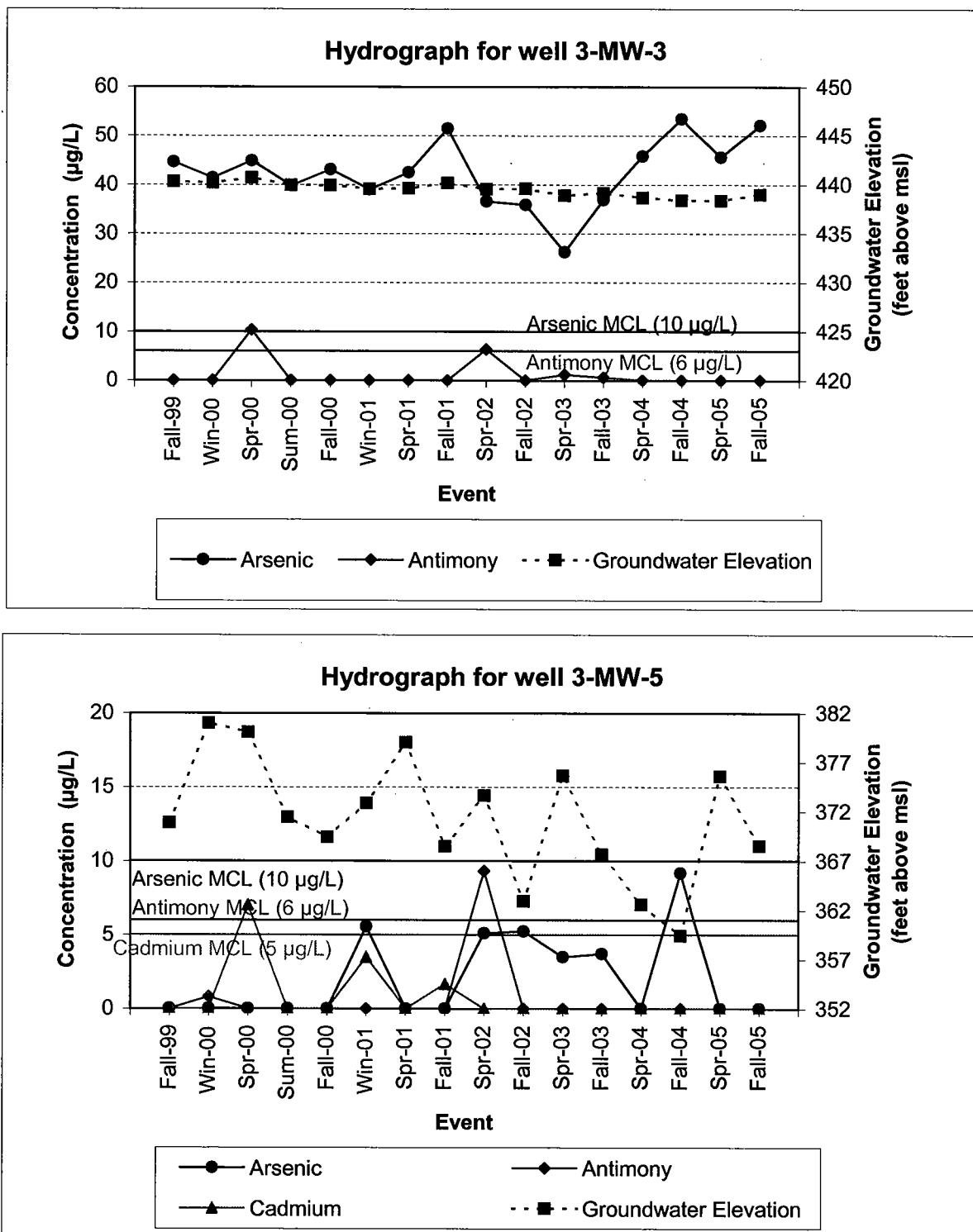


Figure C-1. Site 3 Historical Groundwater Elevations and Concentrations of Arsenic, Antimony, and Cadmium.

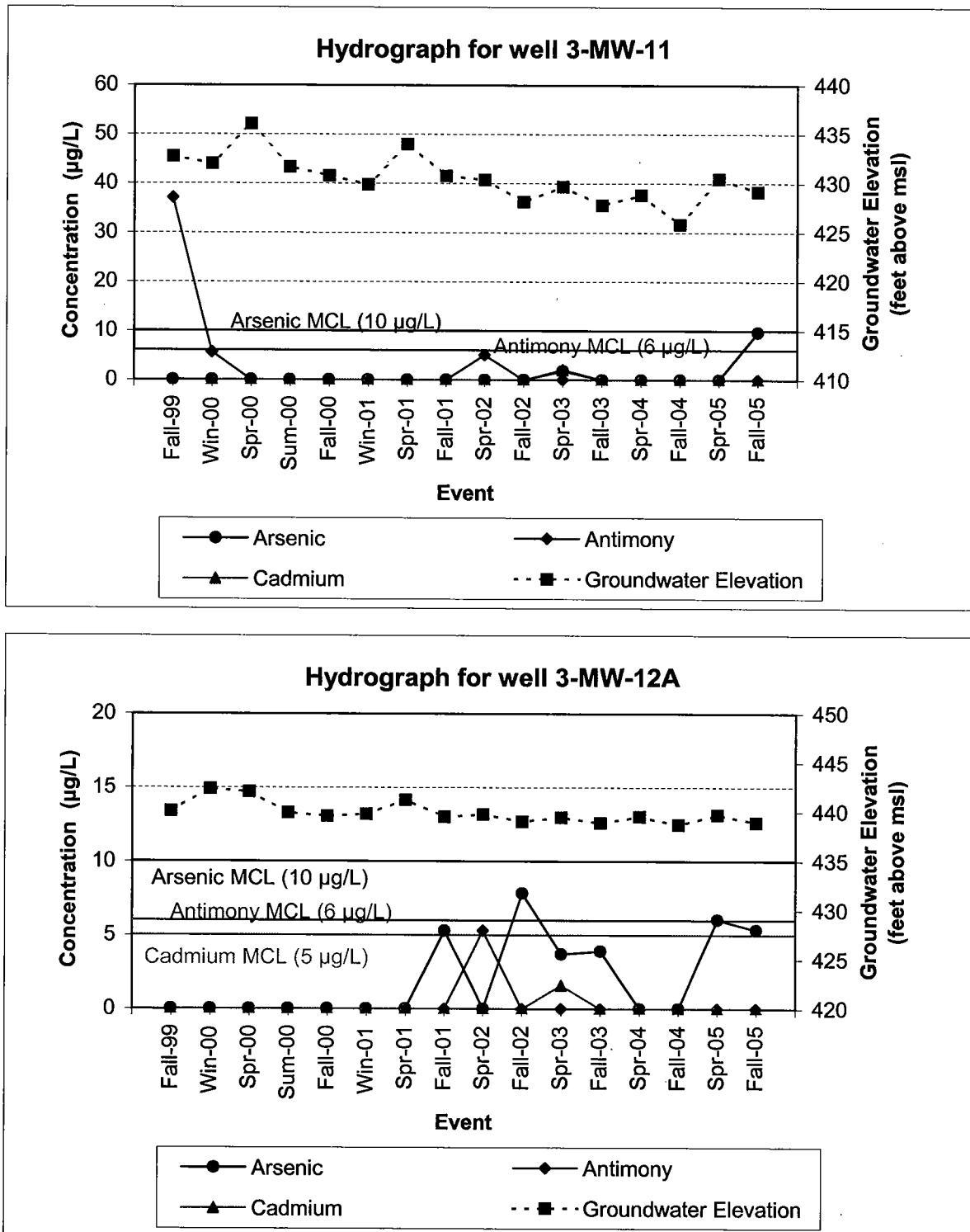


Figure C-1. Site 3 Historical Groundwater Elevations and Concentrations of Arsenic, Antimony, and Cadmium.

APPENDIX D

SUPPORTING TABLES, HEXAVALENT CHROMIUM

Table 4
Hexavalent Chromium in Groundwater
Spring 2005
EPA Method E218.6 (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	Hexavalent Chromium		
			MDL¹	0.1	
3-MW-5	V3MW5M	24-May-05	PQL ¹	0.2	
				0.1	UJ c

Data Validity Qualifier(s):

- UJ - The analyte was not detected above the MDL; however, the MDL is uncertain and may be elevated above normal levels.

Data Validity Comment(s):

- c - The matrix spike and/or matrix spike duplicate recoveries were outside control limits.

Definitions(s):

- MDL - method detection limit
- µg/L - micrograms per liter
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan

Note(s):

- 1 - Values from QAPP Addendum (U.S. Air Force 2004).

Table 5
Hexavalent Chromium in Groundwater
Fall 2004
EPA Method E218.6 (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	Hexavalent Chromium
		MDL ¹	0.1
		PQL ¹	0.2
3-MW-5	V3MW5M	15-Nov-04	0.1 U g

Data Validity Qualifier(s):

- U - The analyte was not detected at or above the MDL.

Data Validity Comment(s):

- g - The data met prescribed criteria as detailed in the QAPP.

Definitions(s):

- MDL - method detection limit
- µg/L - micrograms per liter
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan

Note(s):

- 1 - Values from QAPP Addendum (U.S. Air Force 2004a).

Table 5
Hexavalent Chromium in Groundwater
Spring 2004
EPA Method E218.6 (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	Hexavalent Chromium		
			MDL¹	0.1	
3-MW-5	V3MW5M	12-May-04	PQL ¹	0.2	
				0.1	U g

Data Validity Qualifier:

U - The analyte was not detected at or above the MDL.

Data Validity Comment:

g - The data met prescribed criteria as detailed in the QAPP.

Definitions:

- MDL - method detection limit
- µg/L - micrograms per liter
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan
- SAP - Sampling and Analysis Plan

Note:

1 - Values from SAP Addendum (U.S. Air Force 2000a).

APPENDIX E**SUPPORTING TABLES, 1,4-DIOXANE**

Table 7
1,4-Dioxane in Groundwater
Spring 2005
EPA Method SW8270C (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	1,4-Dioxane		
			MDL¹	0.5	
			PQL¹	3.0	
3-MW-5	V3MW5M	24-May-05	0.57	U	g
3-MW-10	V3MW10	26-May-05	0.56	U	g
3-MW-10	V99W536 (D)	26-May-05	0.57	U	g

Data Validity Qualifier(s):

U - The analyte was not detected at or above the MDL.

Data Validity Comment(s):

g - The data met prescribed criteria as detailed in the QAPP.

Definition(s):

- (D) - duplicate sample
- MDL - method detection limit
- µg/L - micrograms per liter
- NA - not analyzed
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan

Note(s):

- 1 - Values from QAPP Addendum (U.S. Air Force 2004).

Table 8
1,4-Dioxane in Groundwater
Fall 2004
EPA Method SW8270C (µg/L)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	1,4-Dioxane		
			MDL¹	0.47	
3-MW-5	V3MW5M	15-Nov-05	MDL ¹	0.47	UJ b

Data Validity Qualifier(s):

- UJ - The analyte was not detected above the MDL; however, the MDL is uncertain and may be elevated above normal levels.

Data Validity Comment(s):

- b - The surrogate spike recovery was outside quality control criteria.

Definition(s):

- MDL - method detection limit
- µg/L - micrograms per liter
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan

Note(s):

- 1 - Values from QAPP Addendum (U.S. Air Force 2004a).

Table 8
1,4-Dioxane in Groundwater
Spring 2004
EPA Method SW8270C ($\mu\text{g/L}$)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	1,4-Dioxane
			MDL ¹ 0.47 PQL ¹ 3.0
3-MW-5	V3MW5M	12-May-04	0.47 U g

Data Validity Qualifier:

U - The analyte was not detected at or above the MDL.

Data Validity Comment:

g - The data met prescribed criteria as detailed in the QAPP.

Definitions:

- MDL - method detection limit
- $\mu\text{g/L}$ - micrograms per liter
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan
- SAP - Sampling and Analysis Plan

Note:

- 1 - Values from SAP Addendum (U.S. Air Force 2000a).

Table 7
1,4-Dioxane in Groundwater
Spring 2003
EPA Method SW8270C SIM ($\mu\text{g/L}$)
IRP Site 3 (Old Railroad Pumping Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	1,4-Dioxane		
			MDL ¹	0.5	
			PQL ¹	3.0	
3-MW-5	V3MW5M	19-May-03	ND	U	g
3-MW-10	V3MW10	20-May-03	ND	U	g

Data Validity Qualifier:

U - The analyte was not detected at or above the MDL.

Data Validity Comment:

g - The data met prescribed criteria as detailed in the QAPP.

Definitions:

- | | |
|-----------------|---|
| MDL | - method detection limit |
| $\mu\text{g/L}$ | - micrograms per liter |
| ND | - not detected; result is less than the MDL |
| PQL | - practical quantitation limit |
| SAP | - Sampling and Analysis Plan |

Note:

1 - Values from SAP Addendum (U.S. Air Force 2000a).